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Stack Test Results at Phelps-Dodge Corporation Ajo, Arizona. Volume II

Acurex Corp, Mountain View, Calif Aerotherm Div

Prepared for

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In July 1976 at the request of EPA, Region IX, Enforcement Division, the Aerotherm Division of the Acurex Corporation conducted a series of air pollutant mass emissions tests at the new Cornelia Branch copper smelte smelter of the Phelps Dodge Corporation located in Ajo, Arizona. The tests were performed simultaneously at three locations: 1)the main stack, 2)the reverberatory furnace duct and 3)the converter side sulfuric acid plant tail gas duct. Tests for particulate matter (Method 5), sulfur dioxide and sulfuric acid (Method 8) were conducted at each location using a combined sampling train. In addition tests for "condensable particulate matter" were conducted at the main stack and the reverberatory furnace duct using the combined Method 5 and 8 sampling train with an instack filter added.

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Aerotherm Project 7211

STACK TEST RESULTS AT PHELPS-DODGE CORPORATION, AJO, ARIZONA

Volume II

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March 1977

AEROTHERM FINAL REPORT 76-231

Prepared for

EPA Task Officer — L. Bowerman

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APPENDIX A

DAILY ACTIVITIES REPORT

Day #1, July 15, 1976

1. Test crew left San Jose Airport at 9:00 a.m. Arrived at Phoenix Airport at 10:45 a.m. Picked up rental station wagon and loaded luggage by 11:30 a.m., then drove the station wagon to the Hertz truck rental station in South Phoenix. Picked up rental truck at 12:30 p.m. and drove back to the Phoenix air cargo terminal to load sampling equipment. Sampling equipment was loaded by 1:00 p.m. Test crew ate lunch and drove to Ajo, Arizona. Arrived at the motel at approximately 4:30 p.m., checked into the motel, and then drove to the Phelps-Dodge smelter. On arriving at the plant gate at 4:55 p.m., found that the passes for the test crew were at the employment office — which was already closed. Called Gale Perry to arrange for entrance to the plant at 7:00 a.m. the next day. The test crew were instructed about the use of all safety equipment: hard hats, safety glasses, safety shoes, and longsleeve shirts.

Day #2, July 16, 1976

1. Test crew arrived at the smelter at 7:00 a.m. Tried to locate Gale Perry but he was not in the smelter office. The test crews proceeded to the individual test sites and started to unpack the equipment.
2. Test crew finished unpacking at the main stack sampling site. John Robertson of Phelps-Dodge Company stopped by with an electrician. Phelps-Dodge had installed a portable electric generator at the base of the main stack to provide more electrical power at the sampling platform to run all the sampling equipment simultaneously.
3. Robertson requested that we coordinate with Phelps-Dodge personnel so that the tests could be done during the proper portion of the plant cycle.
4. Met with Gale Perry and he showed me where the acid plant sampling site was and where the electrical outlets were. The test crew began to unload equipment at the acid plant site.

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5. The test crew identified an immediate problem at the acid plant test site. The sample ports on the 4 ft diameter duct were approximately 20 inches in length. The 5 ft probe that we had brought along to traverse the acid plant duct would not be able to reach all the sampling points in that duct because of the extra long pipe nipple on the duct.

6. Located Gale Perry and requested a piece of 1/2-inch O.D. stainless steel tubing 0.035 inch wall thickness. This tubing was used to extend the nozzle so that all points on a diameter of the acid plant duct could be reached. The extended pitot tube tips from the 10 ft reverb probe were used so that the nozzle and pitot tube tips were adjacent to each other. This modification was approved by Dan Yee.

7. A man was assigned to unpack all the glassware in the lab provided us by Phelps-Dodge personnel. During the cleaning of the glassware, it was discovered that four stems were too long for the impinger bottles. This meant that the number of spares available to run the tests was reduced.

8. Because of the modification to the acid plant probe, the stainless steel union required to make the acid plant sample probe modification was now unavailable for the 47 mm filter holder. Ordered the stainless steel unions which were needed.

9. The sample port caps at the acid plant were frozen. Tracked down Gale Perry to get a 3 ft pipe wrench. The test crew managed to get the caps off the sample ports. In the process of removing the sample port caps, two crew members received slight acid burns – Densmore on his left arm above his wrist and Sutton on the left side of face. Both Sutton and Densmore washed thoroughly with water to remove any traces of the acid. Both were instructed again to wear safety glasses, gloves and leave the sleeves of their shirts rolled down.

10. The test crew continued to load equipment at each sampling site. The power supply at the acid plant was checked. Noted that one outlet was at 98 volts and the other outlet was at 102 volts. The test crew on the main stack called down to indicate that the electrical outlet at port C on the main stack was dead. I notified Gale Perry of the problem and he said Phelps-Dodge would correct it.

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11. With most of the equipment in place at the acid plant test site and the main stack site, the sampling crew broke for lunch.

12. The Radian test crew were still testing at the reverb furnace ESP outlet, but said that Aerotherm personnel could start loading up the equipment at the same time. Spoke with Bob Collins of the Radian test crew and he gave me the following information regarding conditions at the reverb ESP outlet: -1.4 inches to -2.5 inches water, 115 ft per second, 600°F, 13 percent moisture.

13. Another problem was identified at the reverb ESP test station: no unirails available to support the sampling equipment. Need wooden planks to fabricate a sampling support system for the sample box to traverse the stack. Made plans to do this construction on the 19th of July.

14. Met with Dan Yee to review the sampling schedule. Apparently copper blows are two hours in length, not three hours as previously thought. Because of this, a two hour sampling test is impossible, since it does not leave enough time for port changes. Dan Yee will meet with Phelps-Dodge personnel to review the problem.

15. The test crew at the acid plant measured the upstream and downstream distances to the nearest flow disturbance. The site was ideal and will require a minimum of 12 points. The sample point locations were calculated and marked on the sampling probe.

16. All equipment at each test site was stored in boxes. The acid plant equipment was covered with a tarp.

17. Met with Gale Perry and Dan Yee and worked out a new sampling schedule. Tests now will be 1 hour in length during a 2 hour copper blow. This means it would be possible to test for 1 hour during the copper blow in the morning and for 1 hour during the copper blow in the afternoon.

18. Gale Perry and Clyde Stanley checked on the chemicals which were sent directly to Phelps-Dodge in Ajo. The isopropanol, acetone, silica gel had arrived, but the hydrogen peroxide (H_2O_2) had not. A trace was immediately begun.

19. Requested that Zoher Chiba contact Rich Beer in order to obtain the six stainless steel swagelock unions that we require.

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20. The test crew left the smelter at 4:30 p.m., having completed the installation of the sampling equipment at each test site. The rental truck with the remaining equipment was dropped off at the Marine Motel and the test crew drove to Tucson

Day #3, July 19, 1976

1. The test crew entered the plant at 7:12 a.m. and the individual test crews returned to the test sites to prepare the equipment for the preliminary measurements. All crew members were told to be careful and wear all safety equipment once again especially the people at the acid plant.
2. Met with Gale Perry at 7:40 a.m. to arrange for wooden planks to be delivered to the reverb test site. Also asked Perry to obtain ice from their ice plant, verify the copper blow schedule (estimated to be between 9:30 and 11:30), and check at shipping and receiving to see if any more chemicals had arrived.
3. The following comments record observations made by each crew leader at his test site during the day.

Acid Plant Test Site

1. The test crew measured the stack diameter at the acid plant and found it to be 4 feet.
2. The test crew measured the distances to the downstream and upstream flow disturbances using a rope and determined that the existing sampling site was ideal.
3. Using Figure 1-1 from the Federal Register, a total of 12 sampling points were required - 6 on each of two traverses at 90°. The sampling point locations were marked on the sampling probe using duct tape.
4. The unirail was set up in the vertical traverse mode. The crew were unable to raise the oven high enough to connect the probe outside of the sample port. Therefore the probe had to be put part way into the sample port and then connected to the oven in order for the system to work.
5. A preliminary velocity and temperature traverse was done in the vertical sampling port starting at approximately 2:45 p.m. No static pressure measurement was made.
6. An integrated sample of the gas was collected in a tedlar bag for subsequent analysis in the lab. This completed the day's activities at the acid plant test site.

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Main Stack Test Site

1. The test crew determined the stack diameter using an indirect procedure. The circumference of the stack was measured using a rope. The stack wall thickness was measured at Ports A, B, and C. The stack diameter was calculated to be 253 inches.

2. The test crew measured the distance to the downstream disturbance by suspending a rope with weight on it over the platform. The downstream distance was determined to be four stack diameters. The upstream flow disturbance was greater than two stack diameters away.

3. Using Figure 1-1 from the Federal Register, a total of 36 points were required. Since there were three sampling ports, location of the sampling points was based on 24 traverse points per diameter with only the first 12 points being sampled at each of the three ports.

4. These sampling point locations were marked on the sampling probe using duct tape.

5. The Method 3 and 4 sampling train was assembled at Port A to obtain a simultaneous velocity and temperature traverse and a gas composition and moisture measurement. The sampling train was leak checked at 15 inches Hg (0.05 cfm leak) and the traverse was started at 3:30 p.m. and ended at 3:50 p.m.

6. No testing was done in Ports B and C. This concluded the sampling activities at the main stack for the day.

Reverb ESP Outlet Test Site

1. The test crew measured a distance of 24 feet to the upstream flow disturbance and a distance of 12.5 feet to the downstream flow disturbance.

2. The test crew used the sampling probe to measure the inside diameter of the stack and found it to be 6 feet in diameter. This test site did not meet the ideal requirements for a sampling site.

3. Using Figure 1-1 from the Federal Register, a total of 36 sampling points would be required for the particulate test. The location of the sampling points was determined using Table 1-1 from the Federal Register and these locations were marked on the sampling probe with a high temperature grease marker.

4. A preliminary velocity and temperature traverse was made in Sampling Port A commencing at approximately 2:40 p.m. A maximum velocity head of 1.4 inches water gage and a maximum stack gas temperature of 605°F was measured during the traverse. Points 1, 2, and 3 had lower than usual stack gas temperatures due to the fact that there was in-leakage of cold

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ambient air into the stack around the sampling probe. In-leakage was due to the fact that the sampling probe could not be effectively sealed since the duct temperature was on the order of 500°F to 600°F. A measurement of static pressure indicated -0.7 inch of water. It was later determined that this static pressure measurement was made incorrectly and that the true static pressure was approximately -2.5 inches of water.

5. A velocity and temperature traverse was also made in Port B. Data taken was approximately the same as for Port A. The velocity was somewhat lower because measurements were made at 90° to the plane of the upstream flow disturbance.

6. A gas composition and moisture measurement was made using the combined Method 3 and 4 sampling. This concluded the day's activities at the Reverb ESP sampling site.

Laboratory

1. After completion of the preliminary measurements at each test site, the collected samples and data were taken to the laboratory.

2. The following data was obtained for the gas composition analysis performed by the Orsat.
   - Acid Plant — 0.2% CO_2; 15.3% O_2; 0% CO
   - Reverb ESP — 6.7% CO_2; 9.7% O_2; 0% CO
   - Main Stack — No sample, bag leaked

3. The following data was obtained for the gas moisture analysis performed by measuring the volume of water condensed and the increase in weight of silica gel.
   - Acid Plant — No sample, moisture content = 0
   - Reverb ESP — 12.7%
   - Main Stack — 1.9%

4. The above data were used to calculate the molecular weight of the stack gas.
   - Acid Plant — $M_s = 28.64$; $M_d = 28.64$
   - Reverb ESP — $M_s = 28.00$; $M_d = 29.46$
   - Main Stack — $M_s = 29.24$; $M_d = 29.46$

5. Using the gas composition and moisture data, nozzle sizes were determined for isokinetic sampling at each test site as follows.

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- Acid Plant – ΔH = 3.97" H_2O using 1/4" nozzle
- Reverb ESP – ΔH = 2.52" H_2O using 1/4" nozzle
- Main Stack – ΔH = 4.19" H_2O using 7/16" nozzle

6. Having completed the preliminary calculations, the test crew left the plant.

Day #4, July 20, 1976

1. The test crew arrived at the plant at 7:02 a.m. and went to laboratory to prepare sampling trains.
2. The first copper blow started at 7:55 a.m. and the crew were not prepared to sample so this copper blow was missed.
3. The replacement shipment of H_2O_2 had not arrived at Phelps-Dodge and the test crew borrowed some 3-year old, 35 percent H_2O_2 from Phelps-Dodge to prepare 20 percent and 3 percent H_2O_2 solutions for the impinger trains (reverb – 20 percent).
4. At 11:20 a.m., the crew were informed that the next copper blow was scheduled for 3:00 p.m. to 4:00 p.m. that afternoon.
5. At 11:30 a.m. a meeting was held with Messrs. Robertson, Perry (Phelps-Dodge), Messrs. Chiba and Steiner (Aerotherm), and Mr. Yee (EPA Region IX) to discuss the problem with #1 tap hole on the reverb furnace (needed replacement).
6. Will try to get 1-hour test on copper blow this afternoon and P-D will try and repair #1 tap hole. If it is okay, testing can continue tomorrow.
7. Spoke with Yee at 1:30 p.m. If main stack crew cannot resolve problems with leaks and start the test on time, they should record the time of sampling and start when ready. Other teams should proceed on schedule.
8. Chiba called at 4:09 p.m. to say copper blow had started. Scheduled simultaneous tests to start at 4:15 p.m. Main stack crew had leak in teflon hoses (0.1 cfm for Method 5/8; 0.05 cfm for Method 3/4). Informed Yee of leak at 4:25 p.m.

Acid Plant Test Site

1. Leak checked system but failed to note the leak rate (was less than 0.02 cfm). Started test at 4:15 p.m.
2. Could not measure impinger outlet temperature on Method 5/8 during horizontal traverse.

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3. Forgot to leak check sampling train after transferring from vertical to horizontal port.

4. Failed to collect sufficient sample in Tedlar bag.

5. Purged train at completion of test.

Reverb Furnace ESP Test Site

1. Leak checked sampling trains (0.016 cfm for Method 3/4; <0.02 cfm for Method 5/8) and started sampling at 4:18 p.m. at Port A. Too much data to record every minute and 40 seconds so some data omitted.

2. Pump bearing on Method 3/4 sampling train seemed to be freezing. Probe temperature on Method 5/8 train was too low.

3. Changed ports (A to B) without disconnecting sampling train and no leak check was required.

4. Pump vacuum on Method 5/8 sampling train went to 22 inches Hg at Point #11 on B traverse and remained above 15 inches Hg for the rest of the traverse.

5. Purged impinger train at completion of the test; disassembled sampling train and took components to the laboratory. Insufficient gas sample collected in Tedlar bag.

Main Stack Test Site

1. Method 5/8 train had 0.1 cfm leak; Method 3/4 train had 0.05 cfm leak; problem was in teflon hoses and would require >1 hour to fix.

2. Proceeded with test at 4:17 p.m. with Method 5/8 train in Port A and Method 3/4 train in Port B.

3. Moved Method 5/8 train to Port C and left Method 3/4 train at Port B. Port change took ~1 hour due to need to disassemble adjustable brackets on Method 5/8 train.

4. Finished C traverse at 5:54 p.m. and was unable to start B traverse and complete it before copper blow ended. Hence, only two ports were sampled.

5. Disassembled sampling trains and took components to laboratory for sample recovery.

Laboratory

1. Arrived at the laboratory at 6:15 p.m. with sampling train components. Began sample recovery.

2. Following observations made regarding acid plant samples:

   - 142 mm filter – wet appearance (H_2SO_4 mist)

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   - IPA impingers - clear
   - 50 mm filter - white, no wet appearance
   - H_2O_2 impingers - clear
   - No gas composition data; insufficient sample
   - H_2O condensed = 0

3. Following observations made regarding reverb furnace ESP samples:
   - Acetone washings - clear
   - 142 mm filter - good seal, no penetration
   - Filter holder - teflon pealed off, did not wash
   - IPA impingers - first gingerale color; second light yellow
   - 50 mm filter - sulfur yellow
   - H_2O_2 impingers - both light yellow color
   - No gas composition data; insufficient sample
   - H_2O condensed = 66.6 ml

4. Following observations made regarding main stack samples:
   - 142 mm filter - good seal, light pink color
   - IPA impingers - clear
   - 50 mm filter - white, no wet appearance
   - H_2O_2 impingers - clear
   - CO_2 = 1.2%; O_2 = 17.6%; CO = 0.06%
   - H_2O condensed = 16.6 ml

5. Stanley, Rice, Gilchrist, Sutton, Chiba and Densmore were sent home at 8:15 p.m.

6. Knirck and Steiner left at 9:45 p.m., after charging the filter holders with new filters, preparing the moisture trains and boxing the samples for transportation to the motel.

Day #5, July 21, 1976

1. Yee called Steiner at 5:20 a.m. to say copper blow would take place between 7:00 a.m. and 7:30 a.m. according to P-D.

2. Test crew arrived at the plant at 6:00 a.m. and went directly to laboratory and began sample train preparation.

3. Reverb test crew found leak in teflon hose at 9:01 a.m. (0.017 cfm). Acid plant crew found leak in teflon hose at 9:10 a.m. (0.015 cfm). Main stack crew sent down teflon hose for repairs at 9:28 a.m.

4. Crew left plant at 9:45 a.m. for breakfast since the tests were posponed to the afternoon due to hose leakage.

5. Called Kostow at EPA Region IX and explained problems – unable to predict coppor blow and overtime may cause financial problems with present task order.

6. Crew returned to the plant at 12:15 p.m. and started repairing the leaking teflon hoses. P-D plan to use #3 converter for copper blow at approximately 4:00 p.m.

7. At 1:02 p.m. all three teflon hoses had been repaired and all three sampling crews were ready to test.

8. Talked to Robertson at 2:50 p.m. – next copper blow in #3 converter between 5:00 p.m and 6:00 p.m.

9. At 4:45 p.m. Chiba checked shipping and receiving and indicated our H_2O_2 had arrived at P-D shipping and receiving after 4:00 p.m. and was sent back to Phoenix because there was no one to receive it.

10. At 5:20 p.m. Chiba called to indicate the start of copper blow.

Acid Plant Test Site

1. Changed vertical unirail assembly to allow oven to be raised high enough to set up probe with sample port closed.

2. Leak check at H-port was 0.015 cfm at 15 inches Hg. Started traverse at 5:22 p.m.

3. Leak check at V-port was <0.02 cfm but was not recorded. Started traverse at 6:24 p.m.

4. Had problems with Method 3 pitot tube reading; used ΔP data from Test #1 until problem was corrected.

5. Finished test at 6:54 p.m. and purged train.

Reverb ESP Outlet Test Site

1. Leak check at A-port was <0.02 cfm but was not recorded. Started traverse at 5:25 p.m.

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2. Sampling probe temperature was <250°F; oven temperature okay.

3. Unable to record impinger outlet temperature since thermocouple chord was too short.

4. Changed ports and started at Point #18 on B-traverse. No leak check necessary since equipment was not disassembled.

5. Finished test, purged train for 10 minutes, and took components to laboratory for sample recovery.

Main Stack Test Site

1. Leak check on Method 5/8 train was 0.0 cfm at 15 inches Hg. Start test at 5:20 p.m. at B port.

2. Leak check on Method 5/8 train was 0.003 cfm at 15 inches Hg. Start test at 6:12 p.m. at C port. Start Method 3/4 train at B port.

3. Leak check on Method 5/8 train was 0.005 cfm at 15 inches Hg. Start test at 7:10 p.m. at A port.

4. Finish test at 7:30 p.m. and purge train.

Laboratory

1. Transported samples back to laboratory for sample recovery. Sent Gilchrist, Densmore, Stanley, Rice and Chiba to motel at 8:30 p.m.

2. Following observations were made recovering acid plant samples:
   - 142 mm filter – good seal, white in color, not wet
   - IPA impingers – clear
   - 50 mm filter – white, not wet
   - H_2O_2 impingers – clear
   - CO_2 = 0.13%; O_2 = 11.7%; CO = 0%
   - H_2O condensed = 0

3. Following observations were made recovering reverb ESP samples:
   - 142 mm filter – good seal; light brown dust near center and edges
   - Filter holder – teflon flaking; did not wash with acetone
   - IPA impingers – first dark gingerale color; second light yellow

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- 50 mm filter – light yellow color
- H_2O_2 impingers – clear
- CO_2 = 1.0%; O_2 = 18.1%; CO = 0%
- H_2O condensed = 75.6 ml

4. The following observations were made recovering main stack samples:
    - 142 mm filter – good seal, slight pink color
    - IPA impingers – clear
    - 50 mm filter – white, not wet
    - H_2O_2 impingers – clear
    - CO_2 = 1.6%; O_2 = 17.5%; CO = 0%
5. Sutton, Knirck, and Steiner cleaned all the glassware, prepared for the next day's tests and left the plant at 10:30 p.m.

Day #6, July 22, 1976

1. Arrived at the plant at 7:17 a.m. after notification that copper blow would be at 10 a.m.
2. Made up fresh solutions of H_2O_2 and IPA and charged impinger trains.
3. Pump on Method 3/4 train for Reverb ESP would not draw vacuum. Therefore, a temporary moisture train was assembled, consisting of a polyethylene bottle filled with silica gel with an inlet and outlet. Phelps-Dodge would not lend us a pump.
4. Chiba called at about 9:53 a.m. to let us know the copper blow had started.

Acid Plant Test Site

1. Leak check of 0.01 cfm at 16 inches Hg for vertical traverse. Start test at 10:02 a.m.
2. Measured static pressure incorrectly and will use data from future tests.
3. Leak check <0.02 cfm at 15 inches Hg for horizontal traverse (did not record)
4. Purged train at completion of test and returned components to the laboratory for sample recovery.

Reverb ESP Outlet Test Site

1. Leak check of 0.002 cfm at 19 inches Hg for A-traverse; failed to measure static pressure correctly.

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2. Started test at 9:56 a.m. with probe temperature at ~245°F and oven temperature at ~265°F.
3. The velocity pressure in the stack was lower than during previous tests.
4. Changed sample ports and started B-traverse at point #18.
5. The moisture train fabricated in the laboratory did not work because silica gel plugged the lines and the system leaked under vacuum.
6. At the completion of the test, the train was purged for 10 minutes and the components of the train were taken to the laboratory for sample recovery.

Main Stack Test Site

1. Leak check of 0.004 cfm at 15 inches Hg. Started A-traverse at 9:55 a.m.
2. Vaccum in the train reached 22 inches Hg because velocity pressure in stack had increased. After point #7 everything returned to normal.
3. Leak check of 0.02 cfm at 15 inches Hg. Started B-traverse at 10:29 a.m.
4. Started Method 3/4 train in port A at 10:35 a.m.
5. Leak check of 0.0 cfm at 15 inches Hg. Started C-traverse at 11:00 a.m.
6. After test complete, purged train for 10 minutes and delivered components to the laboratory for sample recovery.

Laboratory

1. Test crew arrived back at the laboratory at 11:50 a.m.
2. After washing probes, Rice, Chiba, Densmore, and Gilchrist were sent to the motel at 12:30 p.m.
3. The following observations were made recovering the acid plant samples:
   - Probe washing – broke glass liner, partial sample recovered
   - 142 mm filter – wet appearance, grey particles all over, good seal
   - IPA impingers – clear
   - 50 mm filter – white, not wet
   - H_2O_2 impingers – clear
   - CO_2 = 0.06%; O_2 = 15.7%; CO = 0%
   - H_2O condensed = 0

4. The following observations were made recovering the samples from the reverb:
    - 142 mm filter – good seal; slight pink color; fibers stuck to exposed stainless steel surface, some fibers left on holder
    - Filter holder – did not wash with acetone; teflon continued to flake off; ordered new filter holder from Mt. View
    - IPA impingers – clear
    - 50 mm filter – yellow color
    - H_2O_2 impingers – clear
    - $CO_2 = 1.4\%$; $O_2 = 16.7\%$; $CO = 0\%$
    - H_2O condensed = 15.4 ml
5. Ordered a new pump from Mountain View for Method 3/4 train at reverb test site.
6. H_2O_2 and Orsat chemicals arrived at shipping and receiving so no need to use chemicals supplied by Phelps-Dodge.
7. Abandoned plans for a test in the afternoon because of the rain.
8. Four crew members returned to the plant at 3:30 p.m. to get equipment ready for next day.
9. Crew left the plant at 5:15 p.m.

Day #7, July 23, 1976

1. Arrived at the plant at 7:07 a.m. and went directly to the lab to prepare chemicals.
2. Each crew then assembled the sampling equipment at the three test sites.
3. Chiba called at approximately 9:00 a.m. to indicate copper blow had started.

Acid Plant Test Site

1. Leak check of 0.012 cfm at 17 inches Hg. Start horizontal traverse at 9:10 a.m.
2. Leak check of 0.004 cfm at 16.5 inches Hg. Start vertical traverse at 10:12 a.m.
3. Some difficulty experienced in holding oven temperature at 250°F. Operational difficulty with bag sampler resulted in no bag sample for gas analysis.
4. At completion of test, purged train and took components to the laboratory for sample recovery.

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Reverb ESP Outlet Test Site

1. Leak check of 0.01 cfm at 16 inches Hg. Start B-traverse at 8:53 a.m.
2. At point #4, ΔP decreased to zero for ~2 minutes, then increased to its normal value.
3. Probe and oven temperature were slightly below 250°F during the traverse.
4. After rearranging equipment, the impinger outlet temperature could be read (~65°F).
5. Failed to measure static pressure correctly and moisture train failed again.
6. Changed sample ports without disconnecting train components; no leak check necessary.
7. Completed test at 9:48 a.m. and purged train for 10 minutes. Sampling train components taken to laboratory for sample recovery.

Main Stack Test Site

1. Leak check of 0.005 cfm at 15 inches Hg. Start A-traverse at 9:07 a.m.
2. At 9:17 a.m., the roof monitor began smoking badly. The problem was traced to closed dampers in the Cottrell precipitator which meant there was little or no suction on the hoods capturing fugitive emissions.
3. By 9:40 a.m. the emissions from the roof monitor decreased in intensity. Start traverse B and start moisture train in port A.
4. At 9:46 a.m. the impinger "U" tube on the first H_2O_2 impinger collapsed. At 9:59 p.m. the "U" tube was replaced and the test restarted.
5. Start traverse C at 10:23 a.m. Emissions from roof monitor continue to be light.
6. Completed test at 10:43 a.m. purging train, and took components to lab for sample recovery.

Laboratory

1. Arrived at laboratory at 11:15 a.m. and began sample recovery.
2. The following observations were made recovering samples from the acid plant:
    - 142 mm filter – good seal, slight wet appearance
    - IPA impingers – clear
    - 50 mm filter – white, not wet
    - H_2O_2 impingers – clear
    - CO_2 = 0.06%; O_2 = 15.7%; CO = 0%
    - H_2O condensed = 0

3. The following observations were made recovering samples from the reverb:

   - 142 mm filter – good seal; pale green color around edges of filter
   - IPA impingers – clear
   - 50 mm filter – yellow color
   - H_2O_2 impingers – clear
   - CO_2 = 0.86%; O_2 = 18.1%; CO = 0.03%

4. The following observations were made recovering samples from the main stack:

   - 142 mm filter – good seal, dust around edges and in center of filter
   - IPA impingers – clear
   - 50 mm filter – white, not wet
   - H_2O_2 impingers – clear
   - CO_2 = 1.9%; O_2 = 17.1%; CO = 0.06%
   - H_2O condensed = 18.3 ml

5. Called acid plant control room at 2:55 p.m. and found out #3 converter was on copper. Called Perry who said matte blow was not long enough because log indicates copper blow should have been at ~4:00 p.m. Packed up samples and left the plant at 4 p.m.

Day #8, July 26, 1976

1. Phoned the converter aisle at 5:15 a.m. and best estimate for copper blow is between 8 and 8:30 a.m. on #1 converter.
2. Arrived at the plant at 5:58 a.m. and went directly to laboratory to prepare sampling trains.
3. New vacuum pump and filter holder arrived for Method 3/4 train at reverb.
4. Roof monitor emissions increased at 8:43 a.m. due to a collar pull.
5. Chiba called to indicate that copper blow had started.

Acid Plant Test Site

1. Leak check of 0.0 cfm at 15 inches Hg. Start the vertical traverse at 8:55 a.m.
2. Leak check of 0.006 cfm at 15 inches Hg. Start the horizontal traverse at 10:10 a.m.
3. ΔP readings were lower during horizontal traverse than previous tests. The pitot was checked and cleaned out but readings were still low.

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4. More adjustment of the orifice ΔH was required during the test to maintain isokinetic conditions.

5. Purged sampling train at completion of test and took components to the laboratory for sample recovery.

Reverb ESP Outlet Test Site

1. Leak check of <0.02 cfm at 15 inches Hg but did not record value. Started A-traverse at 8:50 a.m.

2. Velocity pressures were lower than during previous tests; bag sampler leaked, and no sample could be taken for gas analysis.

3. Sample probe temperature was ~225°F.

4. Leak check of <0.02 cfm at 15 inches Hg; did not record value. Started B-traverse at 9:25 a.m.

5. Velocity pressures increased to normal levels but probe temperature was still low (~235°F).

6. During purge of sampling train, noticed that the neck of the inlet to the 50 mm filter holder was cracked. This crack probably occurred when the train was being disassembled.

7. Returned components to laboratory for sample recovery.

Main Stack Test Site

1. One of pitot tube quick disconnects broke and was replaced with tygon tube which did not leak.

2. Leak check of 0.0 cfm at 15 inches Hg. Start C-traverse at 8:52 a.m.

3. Roof monitor continued to smoke during this test.

4. Method 3/4 train was installed in port A and was run from 8:52 a.m. to 9:31 a.m.

5. Leak check of 0.0 cfm at 15 inches Hg. Start B-traverse at 9:24 a.m.

6. Leak check of 0.001 cfm at 15 inches Hg. Start A-traverse at 9:57 a.m.

7. Sample probe temperature was low during this traverse.

8. Finished test at 10:17 a.m., purged train, and returned components to laboratory.

Laboratory

1. The following observations were made recovering the samples from the acid plant:

   - 142 mm filter – good seal
   - IPA impingers – clear
   - 50 mm filter – filter white, not wet
   - H_2O_2 impingers – clear
   - CO_2 = 0.16%; O_2 = 13.5%; CO = 0%
   - H_2O condensed = 0

2. The following observations were made recovering the samples from the reverb:
   - Sample probe – broke liner during cleaning; sample partially recovered
   - 142 mm filter – slight pink color; some fibers left on holder; did not wash holder; replaced holder with new one
   - IPA impingers – first impinger gingerale color; second impinger clear
   - 50 mm filter – inlet cracked; filter white in color
   - H_2O_2 impingers – clear
   - No gas analysis bag sample
   - H_2O condensed – 27.7 ml
3. The following observations were made recovering the samples from the main stack:
   - 142 mm filter – good seal; light dust load
   - IPA impingers – clear
   - 50 mm filter – white
   - H_2O_2 impingers – clear
   - CO_2 = 1.6%; O_2 = 17.3%; CO = 0%
   - H_2O condensed = 28.3 ml
4. The crew then cleaned all the glassware and took all the sampling train components back to the individual sampling sites in preparation for the next test.
5. Chiba called to indicate the start of copper blow at ~2:53 p.m.

Acid Plant Test Site

1. Leak check of 0.002 cfm at 15 inches Hg. Start horizontal traverse at 2:55 p.m.
2. Many adjustments of orifice ΔH required indicating unsteady flow.

3. Leak check of 0.0 cfm at 15 inches Hg. Start vertical traverse at 4:00 p.m.

4. Purge train and return components to laboratory for sample recovery.

Reverb ESP Outlet Test Site

1. Leak check of <0.02 cfm at 15" Hg; did not record value. Start traverse A at 2:56 p.m.

2. Probe and oven temperatures were maintained at ~250°F and ΔP in stack seemed normal.

3. Measured static pressure properly and got a value of -2.4" H_2O.

4. Purged train after test and returned components to laboratory for cleanup.

Main Stack Test Site

1. Leak check of 0.0 cfm at 15 inches Hg. Start A-traverse at 2:56 p.m.

2. Smoke continues to come out the roof monitor above #3 converter.

3. Leak check of 0.009 cfm at 15 inches Hg. Start B-traverse at 3:27 p.m. Start Method 3/4 train in A port.

4. Leak check of 0.002 cfm at 15 inches Hg. Start C-traverse at 3:58 p.m. The 50 mm filter holder was reversed. Gas was being filtered through the frit and then the filter.

5. At 3:59 p.m. converter foreman reported dampers on fugitive gas hoods were open and no reason could be found for emissions from roof monitor.

6. Finished test at 4:18 p.m. purged train and returned components to the laboratory for sample recovery.

Laboratory

1. Crew arrived at the laboratory for sample recovery at 4:45 p.m.

2. The following observations were made recovering samples from the acid plant:

   - 142 mm filter - good seal, not wet
   - IPA impingers - clear
   - 50 mm filter - white, not wet
   - H_2O_2 impingers - clear

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- CO_2 = 0.36%; O_2 = 10.9%; CO = 0%
- H_2O condensed = 0

3. The following observations were made recovering the samples from the reverb:
   - Sample probe — broke liner during cleaning; sample partially recovered
   - 142 mm filter — slight pink color; some fibers left on holder; did not wash holder; replaced holder with new one
   - IPA impingers — first impinger gingerale color; second impinger clear
   - 50 mm filter — inlet cracked; filter white in color
   - H_2O_2 impingers — clear
   - No bag sample for gas analysis
   - H_2O condensed = 27.7 ml
4. The following observations were made recovering the samples from the main stack:
   - 142 mm filter — good seal; light dust load
   - IPA impingers — clear
   - 50 mm filter — white
   - H_2O_2 impingers — clear
   - CO_2 = 1.6%; O_2 = 17.3%; CO = 0%
   - H_2O condensed = 28.3 ml
5. The crew then cleaned all the glassware and took all the sampling train components back to the individual sampling sites to prepare for the next test.
6. Chiba called to indicate the start of copper blow at ~2:53 p.m.

Acid Plant Test Site

1. Leak check of 0.002 cfm at 15 inches Hg. Start horizontal traverse at 2:55 p.m.
2. Many adjustments of orifice ΔH required indicating unsteady flow.
3. Leak check of 0.0 cfm at 15 inches Hg. Start vertical traverse at 4:00 p.m.
4. Purged train and returned components to laboratory for sample recovery.

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Laboratory

1. Crew arrived at the laboratory for sample recovery at 4:45 p.m.

2. The following observations were made covering samples from the acid plant:

   - 142 mm filter – good seal, not wet
   - IPA impingers – clear
   - 50 mm filter – white, not wet
   - H_2O_2 impingers – clear
   - CO_2 = 0.36%; O_2 = 10.9%; CO = 0%
   - H_2O condensed = 0

3. The following observations were made recovering samples from the reverb:

   - 142 mm filter – tan color, wet appearance
   - Filter holder – teflon being attached; fibers left on holder were put in probe wash
   - IPA impingers – first, second impingers very pale gingerale color
   - 50 mm filter – yellow
   - H_2O_2 impingers – clear
   - CO_2 = 4.1%; O_2 = 13.9%; CO = 0%
   - H_2O condensed = 51.1 ml

4. The following observations were made recovering samples from the main stack:

   - 142 mm filter – light loading brown in color, good seal
   - IPA impingers – clear
   - 50 mm filter – white, not wet
   - H_2O_2 impingers – clear
   - CO_2 = 1.6%; O_2 = 16.8%; CO = 0.03%
   - H_2O condensed = 34.8 ml

5. Gilchrist, Rice, Chiba, and Densmore were sent to the motel at 5:30 p.m. while Sutton, Stanley, Knirck, and Steiner cleaned the glassware for the next day's test.

6. Left the plant at 7:15 p.m.

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Day #9, July 27, 1976

1. Called the smelter at 5:15 a.m. Best estimate for copper blow was 8:00 a.m.
2. Crew arrived at smelter at 5:45 a.m. and went directly to laboratory.
3. These series of tests were to be conducted with the fugitive gas collection system off.
4. Main stack test crew began testing before copper blow started and before the fugitive gas system was turned off. Hence, it was decided to complete these tests with the fugitive gas system on.

Acid Plant Test Site

1. Leak check of 0.0 cfm at 15 inches Hg. Start horizontal traverse at 8:36 a.m.
2. Leak check of 0.004 cfm at 15 inches Hg. Start vertical traverse at 9:45 a.m.
3. Purged train after test and returned components to the laboratory.

Reverb ESP Outlet Test Site

1. Leak check of <0.02 cfm at 15 inches Hg. Start A-traverse at 8:35 a.m.
2. ΔP was very high; test crew found the low pressure side of the pitot magnehelic disconnected at the end of the traverse; hence all sampling was superisokinetic.
3. Reconnected low pressure side of magnehelic for B-traverse. A few minutes before the end of the traverse, a power failure occurred and the contents of the impinger train backed up.
4. Traverse was not completed and components were returned to the laboratory for cleaning.

Main Stack Test Site

1. Leak check of 0.001 cfm at 15 inches Hg. Started C-traverse at 8:05 a.m. before copper blow started. Validyne pressure transducer used in place of magnehelic gage.
2. Started Method 3/4 sampling train at 8:06 in port A.
3. Finished C-traverse at 8:25 a.m , copper blow was just about to start.
4. Leak check of 0.002 cfm at 15 inches Hg. Start B-traverse at 8:45 a.m.
5. Some emissions were still coming from the roof monitor above #3 converter.
6. Leak check of 0.002 cfm at 15 inches Hg. Start A-traverse at 9:27 a.m.
7. Purged train at end of test and brought components to the laboratory for cleaning.

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Laboratory

1. Crew returned to laboratory at 10:05 a.m. The test at the reverb appears to be unsuccessful.

2. Best estimate for next copper blow is 3 to 5 p.m. Sent Gilchrist, Rice, Stanley, Chiba, and Densmore to the motel at 11:00 a.m.

3. The following observations were made recovering the acid plant samples.

   - 142 mm filter - good seal; not wet; barely discolored
   - IPA impingers - clear
   - 50 mm filter - white, not wet
   - H_2O_2 impingers - clear
   - CO_2 = 0.16%; O_2 = 13.2%; CO = 0%
   - H_2O condensed = 0

4. The following observation was made recovering the reverb samples:

   - Test was a failure; samples recovered but no observations made.

5. The following observations were made recovering the main stack samples:

   - 142 mm filter - good seal, light loading
   - IPA impingers - clear
   - 50 mm filter - white, not wet
   - H_2O_2 impingers - clear
   - CO_2 = 1.6%; O_2 = 17.3%; CO = 0%
   - H_2O condensed = 42.1 ml

6. Called EPA Region IX (Kostow and Bowerman) to give them an update on tests. Mentioned the overtime problem again and the troubles at the reverb.

7. The 47 mm filter on the Method 3/4 train at the reverb was replaced with the 142 mm filter whose teflon coating had flaked off.

8. The crew returned to the plant at 3:30 p.m. to prepare for the next test.

9. At 4:12 p.m. Perry called to say that there was an electrical failure on #3 converter and the charge was dumped in the converter aisle.

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10. Sent Gilchrist, Sutton, Rice, Densmore, Knirck to motel at 5:00 p.m.

11. Stanley and Steiner left the plant at 6:00 p.m.

Day #10, July 28, 1976

1. Called smelter at 5:15 a.m. and copper blow was in progress. The next blow was scheduled for 10 to 11 a.m.
2. Called smelter at 8:19 a.m. and the next blow was estimated to take place at 11 a.m.
3. Called again at 9:30 a.m. and again copper blow was scheduled for 11 a.m.
4. Crew arrived at plant at 10:15 a.m. and took sampling equipment to the test sites. The samples collected to date were taken to Phelps-Dodge shipping and receiving for shipment to Mountain View.
5. At 11:05 a.m. the roof monitor was clear and there were no emissions above #1 converter.
6. At 11:09 a.m. the order was given to close the dampers on the fugitive gas collection system. Emissions from the monitor started to increase, especially above #3 converter.

Acid Plant Test Site

1. Leak check of 0.002 cfm at 16 inches Hg. Start vertical traverse at 11:39 a.m.
2. The vacuum in the sampling train (Method 5/8) increased to 21 inches Hg but velocity in the duct was approximately the same as for previous tests.
3. Stopped testing twice to make sure pitot was okay. Could not find reason for high vacuum.
4. At 11:59 a.m. the acid plant control room called to say they were getting small amounts of gas at the acid plant (0 reading on monitor). Converter aisle said that #1 converter was being blown at a low rate.
5. Emissions from the roof monitor are continuous but not excessive. The only difference in monitor emissions with the fugitive gas system off is that emissions are given off from the entire monitor rather than just the portion of the monitor above the converter being blown.
6. There continues to appear to be more emissions leaving the monitor above #3 converter.
7. Leak check of 0.0 cfm at 15 inches Hg. Start horizontal traverse at 12:22 p.m.
8. Purged train after test and returned to laboratory.

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Reverb ESP Outlet Test Site

1. Leak check of 0.002 cfm at 15 inches Hg. Start A-traverse at 11:13 a.m.
2. Both the gas temperature and the velocity pressure in the stack have increased.
3. Static pressure was -3.0 inches H_2O measured at the center of the stack.
4. Started B-traverse at 11:44 a.m. Gas temperature and velocity pressure both up.
5. Purged train after test and returned to laboratory.

Main Stack Test Site

1. Leak check of 0.001 cfm at 15 inches Hg. Start A-traverse at 11:16 a.m. Using Validyne transducer again.
2. Stack gas temperature has increased 100°F but velocity pressure has decreased since fugitive gas system is off.
3. There does not seem to be any significant plume rise (no extra lift due to temperature increase) from the main stack due to changes in stack gas conditions.
4. Should increase nozzle size for future tests because of low velocity.
5. Leak check of 0.001 cfm at 15 inches Hg. Start B-traverse at 11:15 a.m. Start Method 3/4 train in port A.
6. At 12:25 p.m. there was very little smoke leaving the roof monitor.
7. Start C-traverse at 12:31 p.m. and velocities are much higher, perhaps because this sample port is in the plane of the breeching entering the base of the stack. Can't use larger nozzle here.
8. At 12:36 p.m. emissions from the center of the roof monitor started to increase.
9. Purged train after test and returned to laboratory.

Laboratory

1. Arrived at laboratory at 1:15 p.m. with sampling train components.
2. The following observations were made recovering samples from the acid plant:
   - 142 mm filter – good seal, not wet
   - IPA impingers – clear

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- 50 mm filter -- white, not wet
- H_2O_2 impingers – clear
- CO_2 = 0.13%; O_2 = 13.8%; CO = 0%
- H_2O condensed = 0

3. The following observations were made recovering samples from the reverb:
   - 142 mm filter – good seal, light load
   - 142 mm filter (Method 3/4) – bright orange color
   - Filter holder – filter stuck to holder; some fibers left on holder; teflon continues to flake, did not wash filter holder
   - IPA impingers – clear
   - 50 mm filter – light yellow color
   - H_2O_2 impingers – clear
   - CO_2 = 5.8%; O_2 = 11.2%; CO = 0%
   - H_2O condensed = 72.7 ml
4. The following observations were made recovering samples from main stack:
   - 142 mm filter – good seal, light load
   - Method 3/4 filter – deep orange-red color
   - IPA impingers – clear
   - 50 mm filter – slight yellow color
   - H_2O_2 impingers – clear
   - CO_2 = 2.9%; O_2 = 14.4%; CO = 0%
   - H_2O condensed = 50.9 ml
5. Sent Gilchrist, Chiba, Rice, Densmore, and Knirck to the motel at 2:30 p.m. while Steiner, Sutton, and Stanley prepared for the next test.
6. The crew returned at 4:30 p.m. to prepare for the next test.
7. At 7:17 p.m. Chiba called to indicate copper blow had started. This test was conducted with the fugitive gas collection system off. One of the fans at the base of the main stack serving this system was inspected and was found to be off.

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8. The roof monitor emissions don't seem to be any different than when the fugitive gas collection system is working.

Acid Plant Test Site

1. Leak check of 0.0 cfm at 17 inches Hg for the horizontal traverse. Start traverse at 7:19 p.m.
2. Vacuum increased to 21.5 inches Hg during horizontal traverse but ΔP in duct seemed normal.
3. Leak check of 0.02 cfm at 15 inches Hg on vertical traverse. Start traverse at 8:23 p.m.
4. Vacuum did not increase as during first traverse.
5. Purged train after the test and returned to lab.

Reverb ESP Outlet Test Site

1. Leak check of 0.002 cfm at 20 inches Hg. Started A-traverse at 7:16 p.m.
2. As before, gas temperature and velocity pressure in the stack are above normal.
3. Static pressure was -3.2 inches H_2O.
4. Leak check of 0.002 cfm at 16 inches Hg. Started B-traverse at 7:49 p.m.
5. Stack gas temperature and velocity pressure still up.
6. Purged train after test and returned to lab.
7. During disassembly of train, probe was dropped and the glass liner broke.

Main Stack Test Site

1. Used differential pressure transducer to measure ΔP.
2. Leak check of 0.001 cfm at 15 inches Hg. Start C-traverse at 7:20 p.m. Started Method 3/4 train in Port A.
3. As before, the stack gas temperature was ~100°F higher but the ΔP in the stack was lower.
4. Leak check of 0.001 cfm at 15 inches Hg. Start B-traverse at 7:59 p.m.
5. Stack gas temperature was still ~100°F higher than usual and ΔP decreased even further.
6. Leak check of 0.001 cfm at 15 inches Hg. Start A-traverse at 8:41 p.m.
7. ΔP decreased even more; stack gas temperature remained the same.
8. Purged train and returned to lab.

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Laboratory

1. Arrived at the laboratory at 9:20 p.m. to recover samples.
2. After recovering samples from probes, sent Densmore, Gilchrist, Chiba, and Rice to the motel at 10:15 p.m.
3. The following observations were made recovering the samples from the acid plant:
   - 142 mm filter – good seal, barely discolored
   - IPA impingers – clear
   - 50 mm filter – white, not wet
   - H_2O_2 impingers – clear
   - CO_2 = 0.16%; O_2 = 12.8%; CO = 0%
   - H_2O condensed = 0
4. The following observations were made recovering reverb samples:
   - Probe – broke liner, sample partially recovered
   - 142 mm filter – good seal, heavy dust load except in center (brown)
   - Filter holder – large pieces of stuck filter fibers removed; small fibers not removed; did not wash filter holder
   - Method 3/4 filter – bright orange-yellow; white at filter center where gas hits
   - IPA impingers – clear
   - 50 mm filter – yellow in color
   - H_2O_2 impingers – clear
   - CO_2 = 6.2%; O_2 = 10.8%; CO = 0.03%
   - H_2O condensed = 84.9 ml
5. The following observations were made recovering the main stack samples:
   - 142 mm filter – good seal, slight pink color
   - Filter holder – filter stuck to holder; removed large pieces; did not wash filter holder
   - IPA impingers – clear

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- 50 mm filter – light yellow color
- H_2O_2 impingers – clear
- CO_2 = 3.0%; O_2 = 13.4%; CO = 0%
- H_2O condensed = 24.7 ml

6. Left smelter at 11:40 p.m.

Day #11, July 29, 1976

1. Called the smelter at 5:00 a.m. and best estimate for copper blow is 8:30 to 9:00 a.m.
2. Arrived at plant at 6:55 a.m. and set up for in-stack/out-stack tests with the fugitive gas collection system on.
3. Provided two 47 mm in-stack filters for use on the reverb and three 47 mm in-stack filters for use on the main stack. The acid plant will not be tested.
4. Several crew members began packing the equipment at the acid plant (Densmore, Stanley, Rice).

Reverb ESP Test Site

1. Remarked sampling points on sampling probe because of in-stack filter attachment.
2. Leak check of 0.004 cfm at 15 inches Hg. Start A-traverse at 10:12 a.m.
3. Power went off for two (2) minutes at point #6 but did not cause a backup of any impinger solutions.
4. Low stack gas temperatures at first 5 points of traverse since the thermocouple was not positioned at the sampling nozzle (withdrawn 12 inches).
5. The ΔP and stack gas temperature are back to normal conditions now that fugitive gas collection system is back on.
6. Leak check of 0.003 cfm at 15 inches Hg. Start B-traverse at 10:50 a.m. with new in-stack filter.

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7. Measured static pressure at center of duct (-3.0 inches H_2O).

8. Purged train after test and returned to the laboratory.

Main Stack Test Site

1. Leak check of 0.001 cfm at 15 inches Hg. Start C-traverse at 10:20 a.m. using differential pressure transducer to measure velocity.

2. Start Method 3/4 sampling train in port A.

3. Toward the end of C-traverse, the vacuum in the train increased because of the increased pressure drop across the 47 mm in-stack filter.

4. At Points 11 and 12, the vacuum increased from 21 inches to 24 inches Hg and the pump was wide open. Sampling at these points may not be isokinetic.

5. Leak check of 0.006 cfm at 15 inches Hg. Start B-traverse at 11:10 a.m. with a new in-stack filter.

6. Vacuum problem did not occur as on previous traverse.

7. Leak check of 0.004 cfm at 15 inches Hg. Start A-traverse at 11:50 a.m. with a new in-stack filter.

8. No vacuum problems encountered with the traverse.

9. Purged train after test and returned to the laboratory.

Laboratory

1. Arrived at laboratory at 12:40 p.m.

2. The following observations were made recovering the reverb test samples:

   - 47 mm filter (A-traverse) — good seal; filter stuck to screen; light bluish green color
   - 47 mm filter holder — fibers on screen put in probe wash; fibers removed from viton gasket; filter holder rinsed with acetone
   - 47 mm filter (B-traverse) — good seal; dark blue color in center with light blue halo
   - 47 mm filter holder — fibers not stuck to screen; fibers stuck to viton gasket; washed filter holder with acetone

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- 142 mm filter – slightly discolored; removed as much stuck fibers as possible without contamination; good seal
- Filter holder – not washed because of teflon flaking problem
- IPA impingers – clear
- 50 mm filter – yellow color
- H_2O_2 impingers – clear
- CO_2 = 6.3%; O_2 = 10.5%; CO = 0%
- H_2O condensed = 96.4 ml

3. The following observations were made recovering the main stack samples:
   - 47 mm filter (C-traverse) – good seal, light brown color
   - 47 mm filter (B-traverse) – good seal, light brown color
   - 47 mm filter (A-traverse) – good seal, slight pink color; filter stuck to screen
   - 142 mm filter – good seal, slight discoloration
   - IPA impingers – clear
   - 50 mm filter – white, not wet
   - H_2O_2 impingers – clear
   - CO_2 = 1.5%; O_2 = 17.1%; CO = 0%
   - H_2O condensed = 35.8 ml
4. The crews prepared the sampling trains for the next test which was scheduled to start at ~4:00 p.m.

Reverb ESP Test Site

1. Leak check of 0.005 at 15 inches Hg. Start A-traverse at 4:00 p.m.
2. ΔP and stack gas temperature appeared to be normal.
3. Leak check of 0.007 cfm at 15 inches Hg. Start B-traverse at 4:34 p.m. with a new in-stack filter.
4. Crew experienced 5 short power failures during this traverse; however, no solutions backed up in the impinger train.

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5. Static pressure was -2.7 inches H_2O at the center of the stack.

6. Purged train and returned to the laboratory.

Main Stack Test Site

1. Leak check of 0.001 cfm at 16" Hg. Start C-traverse at 4:02 p.m. Start Method 3/4 at port A.

2. No problems with vacuum during this test.

3. Leak check of <0.02 cfm at 15 inches Hg; value was not recorded. Changed in-stack filter holder. Start B-traverse at 4:37 p.m.

4. Leak check of 0.014 cfm at 15 inches Hg. Changes in-stack filter holder. Start A-traverse at 5:15 p.m.

5. Oven temperature was more than 250°F at beginning of the test.

6. Purged train after the test and returned to the laboratory.

Laboratory

1. Sent Gilchrist, Rice, Densmore, and Chiba to the motel at 6:30 p.m. after cleaning out the probes. Sent Stanley to the motel at 7:30 p.m. after completing the gas analysis.

2. The following observations were made recovering the samples from the main stack:

   - 47 mm filter (C-traverse) — good seal; slight pink color; large individual particles present; filter not stuck to screen; fibers stuck to gasket; most fibers removed
   - 47 mm filter (B-traverse) — good seal; light tan color; individual particles; filter not stuck to screen; fibers stuck to gasket; most fibers removed
   - 47 mm filter (A-traverse) — good seal; slight pink color; fibers stuck to screen and gasket; most fibers removed
   - 142 mm filter — good seal; very slightly discolored
   - IPA impingers — clear
   - 50 mm filter — white, not wet
   - H_2O_2 impingers — clear
   - CO_2 = 5.8%; O_2 = 11.5%; CO = 0%
   - H_2O condensed = 46.8 ml

35<

3. The following observations were made recovering samples from the reverb:

   - 47 mm filter (A-traverse) — good seal; light blue color; stuck to screen and gasket; most of fibers removed
   - 47 mm filter (B-traverse) — good seal; light gray color; some fibers left on gasket but not the screen
   - 142 mm filter — good seal; slightly discolored; filter stuck to screen; did not remove all fibers; did not wash filter holder
   - IPA impingers — first pale gingerale; second light yellow
   - 50 mm filter — yellow in color
   - H_2O_2 impingers — clear
   - CO_2 = 5.8%; O_2 = 11.5%; CO = 0%
   - H_2O condensed = 46.8 ml

Day #12, July 30, 1976

1. Arrived at plant at 9:15 a.m. and picked up process data from Perry; rest to follow in the mail.
2. Prepared sampling trains for last test. Stanley, Densmore, Rice, and Chiba returned to Mountain View.

Reverb ESP Test Site

1. Leak check of 0.008 cfm at 20 inches Hg. Start A-traverse at 11:20 a.m.
2. ΔP and stack temperature appear to be normal and no problems with vacuum. Bag sample leaked; no gas sample available for analysis.
3. Leak check of 0.005 cfm at 21 inches Hg. Start B-traverse at 11:55 a.m. with new in-stack filter.
4. Purged train after test and returned components to laboratory for sample recovery.

Main Stack Test Site

1. Leak check of 0.0 cfm at 15 inches Hg. Start A-traverse at 11:15 a.m.
2. At points #11 and #12, the vacuum in the system reached 24.5 inches Hg and sampling was probably nonisokinetic.

36<

3. Leak check of <0.02 cfm at 15 inches Hg; did not record value. Start B-traverse at 11:58 a.m. with new in-stack filter.
4. Vacuum increased to 15 inches Hg, but no higher. Start moisture train in Port A.
5. Leak check of <0.02 cfm at 15 inches Hg; did not record value. Start A-traverse at 12:45 a.m. with new in-stack filter.
6. Vacuum increased to 19 inches Hg during this traverse but did not limit the sampling process.
7. Purged train and returned to laboratory for sample recovery.
8. Copper blow ended at 1:37 p.m.

Laboratory

1. The following observations were made recovering samples from the main stack:
   - 47 mm filter (A-traverse) – good seal; large amount of particles; filter stuck to screen and gasket; most fibers removed
   - 47 mm filter (B-traverse) – good seal; light pink color; heavy dust load; filter stuck to screen and gasket; most fibers removed
   - 47 mm filter (C-traverse) – good seal; light particulate loading; filter stuck to gasket; most fibers removed
   - 142 mm filter – good seal; barely discolored; no lost fibers
   - IPA impingers – clear
   - 50 mm filter – white, not wet
   - H_2O_2 impingers – clear
   - CO_2 = 1.3%; O_2 = 17.2%; CO = 0%
   - H_2O condensed = 97.3 ml
2. The following observations were made recovering samples from the reverb:
   - 47 mm filter (A-traverse) – powder blue color; good seal; filter stuck to screen and gasket; most fibers removed
   - 47 mm filter (B-traverse) – good seal; very slight blue color; filter stuck to screen and gasket; most fibers removed
   - 142 mm filter – good seal; slight discoloration

37<

- IPA impingers — first impinger dark gingerale color; second impinger clear
- 50 mm filter — yellow in color
- H_2O_2 impingers — clear
- No gas analysis; sample bag leaked
- H_2O condensed = 98.4 ml

3. Having completed all the field tests before the smelter shut down (7/31/76), the crew packed the equipment and left the smelter for the last time at 5:15 p.m.

APPENDIX B

Acid Plant

No Punch
PLANT Phelps Dodge Ajo Arizona
LOCATION Acid Plant
STACK DIAMETER (IN.) 48" = 12.57 Ft^2
DUCT DIMENSIONS (IN.) X (IN.)

DATE 7/20/76
4,01 TIME 4:15 pm
RUN 1

4,02 OPERATORS G Sutton, S Densmore
STATIC PRESSURE (IN.WG.)
4,03 AMBIENT PRESSURE (IN.HG.) 28.23
TYPE S PITOT COEFFICIENT 0.811

STACK PRESSURE (IN.HG.) = +2.7 "H_2O = 28.43
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{WO}

METER BOX NUMBER 0009
ORIFICE METER COEFFICIENT 0.678
4,05 PROBE LENGTH (FT.) 5'
NOZZLE DIAMETER (IN.) 1/4"

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F) Ts	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.) ΔP	Orifice Meter (in. wg.) ΔH	Gas Meter Volume (ft.³) V_M	Pump Vacuum (in. hg.)
V-1	4:15	101	260	68	248	80	81	.44	1.698	320,566	7
V-2	4:20	98	259	55	249	80	80	.9	3.474	324.575	14
V-3	4:25	105	320	52	245	79	79	.9	3.47	329.49	14.0
V-4	4:30	113	242	52	247	80	79	.9	3.47	334.71	14.5
V-5	4:35	119	251	53	247	81	80	.9	3.47	339.91	15
V-6	4:40	124	250	53	246	81	79	.8	3.09	345.11	13
	4:45									350.104	
H-1	5:20	146	226		115	84	85	.9	3.47	350.104	14
H-2	5:25	143	250		257	83	84	1.0	3.86	355,24	16.5
H-3	5:30	145	245		256	83	83	1.0	3.86	360.59	16.5
H-4	5:35	148	251		246	83	83	.85	3.28	366.07	10
H-5	5:40	148	257		251	83	82	.8	3.09	371.23	9
H-6	5:45	148	252		250	82	82	.7	2.7	376.15	7.5
	5:50									380.816	
	100MIN.	Average 129.2				Average 81.6	Average 81.4		Average 3.23	Total	
						Average 81.5					

EOF

AVG $\sqrt{\Delta P}$ = .91

V_M = 60.25

Ajo Acid Plant RUN 1

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\, H_2O}{M_{H_2O}}\right)\left(\frac{R\, T_{std}}{P_{std}}\right)$$

$$= 0.0474\, V_{1c}$$

$$= 0.0474$$

$$= \qquad ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (\qquad)\left(\frac{\qquad \frac{}{13.6}}{\qquad}\right)$$

$$= \qquad ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$=$$

2. Stack Gas Composition *(data from test #2)*

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \cancel{\%CO})$$

~~+0.64 (%SO~~$_2$~~)~~

$$= 0.44\ (0.133) + 0.32\ (11.733) + 0.28\ (88.134 + 0) + 0.64\ (\ 0\ )$$

0.059 3.755 24.678

= 28.49 lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.49\ (1-\ 0\ ) + 18\ (\ 0\ )$$

= 28.49 lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48 \times .811 \times 0.91 \sqrt{\frac{588.2}{28.43 \times 28.49}}$$

= 53.76 ft/sec

$$Q_s = 3600\,(1 - B_{wo})\,V_{s,avg}\,A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\,(1 - 0\ )\,53.76)(12.57)\left(\frac{530}{588.3}\right)\left(\frac{28.43}{29.92}\right)$$

$= 2082521$ scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\, H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\,V_{1c}$$

$$= 0.0474$$

$V_{W,STD} = 0$ ft³

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,(60.25)\left(\frac{28.23 + \frac{3.24}{13.6}}{81.5 + 460}\right)$$

$= 56.097$ ft³

V_m correction factoe 0.995

$= 56.379$ ft³

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$B_{wo} = 0$$

5. Concentration of Particulate Matter

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

at 0sec	1st reading	Equilibrium
$= \frac{131.73}{56.379} (2.205 \times 10^{-6})$	$\frac{135.03}{56.379} (2.205 \times 10^{-6})$	$\frac{142.16}{56.379} (2.205 \times 10^{-6})$
$= 5.152 \times 10^{-6}$ lb/ft³	$= 5.2811 \times 10^{-6}$	$= 5.5599 \times 10^{-6}$

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

at 0sec	1st reading	Equilibrium
$= (2082521)(5.152 \times 10^{-6})$	$(2,082,521)(5.2811 \times 10^{-6})$	$(2,082,521)(5.5599 \times 10^{-6})$
$= 10.7291$ lb/hr	$= 10.9979$ lb/hr.	$= 11.5787$ lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6}\right)\right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(588.2) \left\{0.00267\ (\ 0\ ) + \frac{60.55}{541.5} \left(28.23 + \frac{3.24}{13.6}\right)\right\}}{(60)\ (53.76)(28.43)(0.000341\quad)}$$

$= 99.8$

8. Concentration of Sulfur Trioxide/Acid Mist

ACID PLANT

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(13.40 - 0.05)(0.0130)\left(\frac{325}{100}\right)}{56.379}$$

$= 1.080 \times 10^{-6}$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$= 2082521 \times 1.080 \times 10^{-6}$

$= 2.25$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(39.25 - .05)(.1115)\left(\frac{390}{10}\right)}{56.379}$$

$= 0.000213$ lb/ft^3

11. Emission Rate of Sulfur Dioxide

$ER = Q_s C_{SO_2}$

$= 2082521 \times .000213$

$= 444$ lb/hr.

No Punch
PLANT Phelps - Dodge Ajo Arizona
LOCATION Acid Plant
STACK DIAMETER (IN.) 48''
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/21/76
TIME 5·10
RUN 2

4.02 OPERATORS G Sutton, S Dunsmore

4.03
STATIC PRESSURE (IN.HG.)
AMBIENT PRESSURE (IN.HG.) **28.16**
TYPE S PITOT COEFFICIENT **0.811**

STACK PRESSURE (IN.HG.) **28.35**
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{WO}

4.05
METER BOX NUMBER **0009**
ORIFICE METER COEFFICIENT **0.678**
PROBE LENGTH (FT.) 5'
NOZZLE DIAMETER (IN.) 1/4''

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
H-1	5:22	122	249	67	251	80	80	.9	3.474	392.908	13
H-2	5:27	125	244	60	252	80	80	1.0	3.86	398.004	14
H-3	5:32	127	249	62	252	80	80	.95	3.667	403.30	15
H-4	5:37	128	246	63	252	79	79	.8	3.1	408.575	13
H-5	5:42	128	250	62	252	79	79	.7	2.7	413.59	11
H-6	5:47	128	251	63	252	79	79	.65	2.51	418.23	10
	5:52									422.699 29.791	
V-1	6:24	123	255	64	220	77	78	.85	3.28	422.704	13
V-2	6:29	136	251	62	262	77	78	.8	3.10	427.650	13
V-3	6:34	157	249	63	242	77	78	.9	3.474	432.59	12.5
V-4	6:39	161	252	64	246	78	78	.85	3.28	437.60	14
V-5	6:44	162	251	65	255	78	78	.7	2.7	442.71	11
V-6	6:49	163	250	66	256	78	78	.6	2.3	447.365	9.5
	6:54									451.682 28.978	
	60 MIN.	Average 138.3				Average 78.5	Average 78.75		Average 3.12	Total 58.769	
						Average 78.625					

EOF

5983

538.6 $\sqrt{\Delta P} = .89$

1130 Acid Plant Run 2

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{lc}\left(\frac{\rho\, H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474$$

$$= 0\ \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (\qquad)\left(\frac{\qquad\ \overline{13.6}}{\qquad}\right)$$

$$= 0\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (0.133) + 0.32\ (11.733) + 0.28\ (88.134 + 0) + 0.64\ (\ 0\ )$$

$= 28.49$ lb/lb-mole

$$M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$$

$$= 28.49\ (1 -\ 0\ ) + 18\ (\ 0\ )$$

$= 28.49$ lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \times .84 \times 0.89 \sqrt{\frac{598.3}{28.35 \times 28.49}}$$

$= 53.1$ ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - 0\ )\ (50.68)(1256)\left(\frac{530}{598.3}\right)\left(\frac{28.35}{29.92}\right)$$

$$= 2015279 \text{ scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$V_{w,STD} = 0 \text{ ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (58.769)\left(\frac{28.16 + \frac{3.12}{13.6}}{78.625 + 460}\right)$$

$$\frac{58.769}{.995} = 59.06$$

$$= 54.858 \text{ ft}^3$$

V_M CORRECTION FACTOR 0.995

55.134 ft.^{3}

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$B_{wo} = 0$

5. Concentration of Particulate Matter

at 0 sec.	1st Reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{67.46}{55.134} (2.205 \times 10^{-6})$	$\frac{68.06}{55.134} (2.205 \times 10^{-6})$	$\frac{85.46}{55.134} (2.205 \times 10^{-6})$
$= 2.6980 \times 10^{-6}$ lb/ft³	$= 2.7220 \times 10^{-6}$	$= 3.4178 \times 10^{-6}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (2015278)$	$(2{,}015{,}278)(2.7220 \times 10^{-6})$	
$= 5.4371$ lb/hr	$= 5.4855$ lb/hr.	$= 6.8879$ lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6}\right)\right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(598.3) \left\{ \cancel{0.00267\ (0\ )} + \frac{59.06}{538.6} \left(28.16 + \frac{3.12}{13.6}\right)\right\}}{(60\ )(53.1)(28.35)(.000341\ \ )}$$

$$= 100.8$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right)\left(N\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(2.75 - 0.05\ )(0.0130)\left(\frac{220}{100}\right)}{55.139}$$

$$= 1.513 \times 10^{-7}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= 2015278 \times 1.513 \times 10^{-7}$$

$$= 0.305\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{(V_t - V_{tb}) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(25.25 - .05)(.1115)\left(\frac{490}{5}\right)}{55.134}$$

$= 0.000352$ lb/ft^3

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$= 2015278 \times .000352$

$= 709$ lb/hr.

No Punch
PLANT Phelps Dodge Ajo Arizona
LOCATION Acid Plant
STACK DIAMETER (IN.) 48"
DUCT DIMENSIONS (IN.) x (IN.)

4,01
DATE 7/22/76
TIME 9:30 AM
RUN 3

4,02 OPERATORS G. Sutton, S. Densmore
STATIC PRESSURE (IN.WG.)
4,03 AMBIENT PRESSURE (IN.HG.) 28.18
TYPE S PITOT COEFFICIENT 0.811

STACK PRESSURE (IN.HG.) 28.38
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

METER BOX NUMBER 0009
4,05 ORIFICE METER COEFFICIENT 0.678
PROBE LENGTH (FT.) 5'
NOZZLE DIAMETER (IN.) 1/4"

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	ΔP Velocity Head (in. wg.)	ΔH Orifice Meter (in. wg.)	VM Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
V-1	10.02	119	243	67	256	81	81	.75 .866	2.895	461,292	10
V-2	10.07	122	255	60	241	82	82	1.0	3.86	465,90	11
V-3	10.12	130	250	60	259	83	84	1.0	3.86	471,185	11.5
V-4	10.17	132	253	61	253	82	84	.9 .949	3.47	476.595	11
V-5	10.22	134	255	62	255	83	84	.8 .894	3.1	481,905	9
V-6	10.27	135	256	64	257	83	84	.7 .837	2.7	486,845	4
	10.32 30									491,541 30.299	
H-1	11.10	132	251	66	221	74	80	.9 .949	3.47	492.505	10.5
H-2	11.15	130	251	62	261	79	79	1.0	3.86	497,630	11.5
H-3	11.20	137	252	64	247	80	78	1.0	3.86	503,020	12
H-4	11.25	141	255	66	250	80	78	.85 .922	3.28	508.42	10
H-5	11.30	145	251	66	250	81	79	.75 .866	2.9	513.47	9.5
H-6	11.35	150	257	68	251	82	80	.6 .775	2.3	518.24	7
	11:40 30									522.557 30.052	
		Average 134.2				Average 81.25 Average	Average 81.08 81.17	.921	Average 3.296	Total 60.351	

EOF

594.2 541.2

Ajo Acid Plant RUN 3

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\, H_2O}{M_{H_2O}}\right) \left(\frac{R\, T_{std}}{P_{std}}\right)$$

$$= 0.0474\, V_{1c}$$

$$= 0.0474$$

$$= \quad ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (\qquad)\ \left(\frac{\qquad \overline{13.6}}{}\right)$$

$$= \quad ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (0.067) + 0.32\ (15.733) + 0.28\ (84.200 + 0) + 0.64\ (\ 0\ )$$

$$0.029 \qquad 5.035 \qquad 23.576$$

$$= 28.64 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.64\ (1-\ 0\ ) + 18\ (\ 0\ )$$

$$= 28.64 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \times 0.811 \times 0.921 \sqrt{\frac{594.2}{28.38 \times 28.64}}$$

$$= 54.6 \text{ ft/sec}$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1-\ 0\ )\ (54.6)(12.56)\left(\frac{530}{594.2}\right)\left(\frac{28.38}{29.92}\right)$$

$$= 2088713 \text{ scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$V_{w,STD} = 0 \text{ ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (60.351)\left(\frac{28.18 + \frac{3.296}{13.6}}{81.17+460}\right)$$

$V_{M\,corr} = 60.654$

$$= 56.134 \text{ ft}^3$$

V_M correction factor 0.995

56.416 ft^3

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

$B_{wo} = 0$

5. Concentration of Particulate Matter

at 0 sec	1st Reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{41.02}{56.416} (2.205 \times 10^{-6})$	$\frac{42.82}{56.416} (2.205 \times 10^{-6})$	$\frac{63.97}{56.416} (2.205 \times 10^{-6})$
$= 1.6033 \times 10^{-6}$ lb/ft³	$= 1.6736 \times 10^{-6}$	$= 2.5002 \times 10^{-6}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
=(2085713)	(2088713) (1.6736×10^{-6})	(2088713) (2.5002×10^{-6})
=33487 lb/hr	=34957 lb/hr.	=5.2223 lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{0.00267\ V_{lc} + \frac{V_m}{T_m}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(594.2)\left\{0.00267\ (0) + \frac{60.654}{541.2}\left(28.18 + \frac{3.296}{13.6}\right)\right\}}{(60)(546)(28.38)(3.41 \times 10^{-4})}$$

$$= 99.5$$

8. Concentration of Sulfur Trioxide/Acid Mist Acid Plant

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(23.60 - 0.05)(0.0107)\left(\frac{232}{100}\right)}{56.416}$$

$$= 1.119 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= 2088713 \times 1.119 \times 10^{-6}$$

$$= 2.34\ \text{lb/hr}$$

10. **Concentration of Sulfur Dioxide**

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(28.65 - .05)(-1115)\left(\frac{470}{5}\right)}{56.416}$$

$= 0.000374$ lb/ft^3

11. **Emission Rate of Sulfur Dioxide**

$ER = Q_s C_{SO_2}$

$= 2088713 \times 0.000374$

$= 781$ lb/hr.

No Punch

PLANT *Phelps-Dodge, Ajo Arizona*
LOCATION *Acid Plant*
STACK DIAMETER (IN.) *48"*
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE *7/23/76*
TIME *8:15 am*
RUN *4*

4,02 OPERATORS *Sutton*

4,03
STATIC PRESSURE (IN.HG.) ~~[illegible]~~
AMBIENT PRESSURE (IN.HG.) *28.25*
TYPE S PITOT COEFFICIENT *0.811*

4,07
STACK PRESSURE (IN.HG.) ~~[illegible]~~ 28.45
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo} *0*

4,05
METER BOX NUMBER *0009*
ORIFICE METER COEFFICIENT *0.678*
PROBE LENGTH (FT.) *5*
NOZZLE DIAMETER (IN.) *0.25*

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F) TS	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp TM Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.) ΔP	Orifice Meter (in. wg.) ΔH	Gas Meter Volume (ft.³) VM	Pump Vacuum (in. hg.)
H-1	9:10	122	249	67	243	80	81	0.8 .849	3.47	530.605	11
H-2	9:15	120	251	60	256	81	81	1.0	3.86	535.67	12
H-3	9:20	131	254	62	268	81	82	1.0	3.86	541.015	13
H-4	9:25	138	250	64	256	82	81	0.85 .922	3.28	546.52	13
H-5	9:30	140	254	64	237	83	82	0.8 .894	3.08	551.66	10
H-6	9:35	139	254	62	267	82	81	0.7 .837	2.7	556.575	9
	9:40									561.215	
V-1	10:12	137	249	70	152	80	81	0.6 .775	2.3	561.215	7
V-2	10:17	147	252	62	273	81	81	0.95 .975	3.67	565.72	11
V-3	10:22	159	252	65	276	82	81	0.8 .948	3.47	570.835	11
V-4	10:27	162	254	69	250	84	81	0.85 .922	3.28	576.000	11
V-5	10:32	160	252	68	264	83	81	0.8 .894	3.08	581.11	10
V-6	10:37	160	254	70	275	84	82	0.6 .775	2.3	586.03	7.5
	10:42									590.452	
	60MIN	Average 142.9				Average 81.917	Average 81.25	0.908	Average 3.196	Total 59.847	
						Average 81.58					

EOF

6029

541.58

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{lc} \left(\frac{\rho\, H_2O}{M_{H_2O}}\right) \left(\frac{R\; T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474$$

$$= \qquad \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71 \left(\qquad\right) \left(\frac{\qquad \overline{13.6}}{\qquad}\right)$$

$$= \qquad \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$=$$

2. Stack Gas Composition (data from test #3)

$$M_d = 0.44\,(\%CO_2) + 0.32\,(\%O_2) + 0.28\,(\%N_2 + \%CO)$$

$$+0.64\,(\%SO_2)$$

$$= 0.44\,(0.067) + 0.32\,(15.733) + 0.28\,(84.200 + 0) + 0.64\,(0)$$

$$= 28.64 \text{ lb/lb-mole}$$

$$M_s = M_d\,(1-B_{wo}) + 18\,B_{wo}$$

$$= 28.64\,(1-0) + 18\,(0)$$

$$= 28.64 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48 \times .811 \times .908 \sqrt{\frac{602.9}{2845 \times 28.64}}$$

$$= 54.2 \text{ ft/sec}$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - 0\ )\ (54.2)(1256) \left(\frac{530}{6029}\right)\left(\frac{28.45}{29.92}\right)$$

$= 2048531$ scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$V_{W,STD} = 0$ ft³

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (59687) \left(\frac{2825 + \frac{3.196}{13.6}}{81.583+460}\right)$$

$= 55.597$ ft³

V_M correction factor 0.995

55.876 ft³

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

$B_{wo} = 0$

5. Concentration of Particulate Matter

at 0 sec	1st reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{113.77}{55.876} (2.205 \times 10^{-6})$	$\frac{113.77}{55.876}(2.205 \times 10^{-6}$	$\frac{155.47}{55.876}(2.205 \times 10^{-6})$
$= 4.4896 \times 10^{-6}$ lb/ft³	$= 4.4896 \times 10^{-6}$	$= 6.1352 \times 10^{-6}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (2048531)(4.4896 \times 10^{-6})$	$(2,048,531)(4,4896 \times 10^{-6})$	$(2,048531)(6.1352 \times 10^{-6}$
= 9.1972 lb/hr	= 9.1972 lb/hr.	= 12.5682 lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\, T_s \left\{ 0.00267\, V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\, P_s\, A_n}$$

$$= \frac{(1.667)(602) \left\{ 0.00267\ (0) + \frac{59.99}{541.6} \left(28.25 + \frac{3.196}{13.6} \right) \right\}}{(60)\ 54.2)(28.45)(3.41 \times 10^{-4})}$$

$$= 100.5$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(22.85 - 0.05)(0.0107)\left(\frac{234}{100}\right)}{55.597}$$

$$= 1.1089 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\, C_{H_2SO_4}$$

$$= 2048531 \times 1.109 \times 10^{-6}$$

$$= 2.27\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{(V_t - V_{tb})\,(N)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(26.45 - .06)(.107)\left(\frac{680}{1}\right)}{55.597}$$

$= 0.00232$ lb/ft^3

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$= 2048531 \times 0.00232$

$= 475$ lb/hr.

No Punch
PLANT Phelps Dodge
LOCATION Ajo, Arizona Acid Plant
STACK DIAMETER (IN.) 48"
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 1/26/76
TIME 8 25 AM
RUN 5

4,02 OPERATORS Sutton, S. Dunsmore
4,03
STATIC PRESSURE (IN.HG.) -7
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.[illegible]11

STACK PRESSURE (IN.HG.) 28.39
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0009
ORIFICE METER COEFFICIENT 0.678
PROBE LENGTH (FT.) 5'
NOZZLE DIAMETER (IN.) 1/4"

PARTICULATE SAMPLING DATA

4,08

		Ts				TM		ΔP	ΔH	VM	
Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
V-1	8 55	108	246	73	256	82	83	.75 .866	2.8	605.439	9
V-2	9.00	110	241	69	258	83	83	1.0	3.86	609.99	13
V-3	9.05	126	249	74	259	83	83	1.05 1.025	4.05	615.30	13
V-4	9.10	136	250	77	256	84	84	.95 .975	3.7	620.81	12
V-5	9.15	142	248	77	254	83	85	.9 .948	3.5	626.10	11
V-6	9.20	146	255	77	254	84	84	.75 .866	2.8	631.14	8.5
	9.25									635.744 30.355	
H-1	10.10	128	244	81	246	81	80	.2 .438	.81	636.438	3.5
H-2	10.15	128	243	73	250	82	82	.3 .548	1.1	639.00	4
H-3	10.20	135	248	72	247	82	82	.38 .603	1.46	641.91	5
H-4	10.25	138	244	73	248	83	82	.45 .671	1.73	645.31	6
H-5	10.30	140	250	72	247	83	81	.5 .707	1.93	648.96	6
H-6	10.35	142	246	72	247	83	81	.6 .775	2.31	652.77	7
	10.40									657.034 20.596	
	60 min.	Average 131.6				Average 82.75 Average 82.542	Average 82.333	0.787	Average 2.5[illegible]	Total 50.951	

EOF

591.6 542.54

Ajo Acid Plant Run 5

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{lc} \left(\frac{\rho H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474$$

$$= \qquad \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (\qquad)\left(\frac{\qquad \overline{13.6}}{\qquad}\right)$$

$$= \qquad \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$=$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (0.167) + 0.32\ (13.5) + 0.28\ (86.333 + 0) + 0.64\ (0)$$

$$\quad 0.073 \qquad 4.320 \qquad 24.173$$

$$= 28.57 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$$

$$= 28.57\ (1 - 0) + 18\ (0)$$

$$= 28.57 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \times 0.811 \times 0.787 \sqrt{\frac{591.6}{2839 \times 28.57}}$$

$$= 46.6 \text{ ft/sec}$$

$$Q_s = 3600\,(1 - B_{wo})\,V_{s,avg}\,A\left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\,(1-\ 0\ )\ 46.6\,(256)\left(\frac{530}{592}\right)\left(\frac{2839}{29.92}\right)$$

$= 1789930$ scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$V_{W.STD} = 0$ ft³

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (50.951)\left(\frac{28.19 + \frac{2.504}{13.6}}{82.542 + 460}\right)$$

$$\frac{50.951}{0.995} = 51.21$$

$= 47.191$ ft³

V_M correction factor 0.995

$= 47.428$ ft³

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

$B_{wo} = 0$

5. Concentration of Particulate Matter

at 0 sec.	1st Reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{72.30}{47.428} (2.205 \times 10^{-6})$	$\frac{72.88}{47.428} (2.205 \times 10^{-6}$	$\frac{90.18}{47.428} (2.205 \times 10^{-6})$
$= 3.3613 \times 10^{-6}$ lb/ft³	$= 3.3883 \times 10^{-6}$	$= 4.1926 \times 10^{-6}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$

$= (1789930)(3.3613 \times 10^{-6})$	$(1789930)(3.3883 \times 10^{-6})$	$(1789930)(4.1926 \times 10^{-6})$
= 6.0166 lb/hr	= 6.0648 lb/hr.	= 7.5045 lb/hr.

7. **Percent Isokinetic**

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(592) \left\{ 0.00267\ (0) + \frac{51.21}{54254} \left(28.19 + \frac{2.504}{13.6} \right) \right\}}{(60)(46.6)(28.39)(0.000341)}$$

$$= 97.6$$

8. **Concentration of Sulfur Trioxide/Acid Mist**

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(17.20 - .05)(.0107)\left(\frac{440}{1}\right)}{47.191}$$

$$= 1.8478 \times 10^{-4}\ \text{lb/ft}^3$$

9. **Emission Rate of Sulfur Trioxide/Acid Mist**

$$ER = Q_s\ C_{H_2SO_4}$$

$$= 1789930 \times 1.8478 \times 10^{-4}$$

$$= 331\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(30.15-.05)(.197)\left(\frac{445}{5}\right)}{47.191}$$

$= 0.000407$ lb/ft^3

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$= 1789930 \text{ X} 0000407$

$= 728$ lb/hr.

No Punch
PLANT Phelps - Dodge Ajo Arizona
LOCATION Acid Plant
STACK DIAMETER (IN.) 48"
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/26/76
TIME 1:40
RUN #6

4,02 **OPERATORS** G. Sutton, S. D[illegible]

4,03
STATIC PRESSURE (IN.WG.)
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.811

STACK PRESSURE (IN.HG.) 28.39
4,07 **MOLECULAR WEIGHT (LB/LB-MOLE)**
B_{wo}

4,05
METER BOX NUMBER 0009
ORIFICE METER COEFFICIENT 0.678
PROBE LENGTH (FT.) 5'
NOZZLE DIAMETER (IN.) 1/4"

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
H-1	2:55	102	243	68	246	80	82	.65 .806	2.5	640.825	7
H-2	3:00	101	254	59	246	81	82	1.2 1.095	4.4	646.15	12
H-3	3.05	102	250	63	258	81	81	1.15 1.08	4.23	616.63	12.5
H-4	3.10	108	245	67	253	82	82	1.05 1.025	3.9	662.31	11.5
H-5	3.15	112	245	69	255	83	83	.95 .975	3.7	667.71	10.5
H-6	3.20	115	249	66	254	82	82	.8 .894	3.1	673.09	9.5
	3.25									678.616 37.791	
V-1	4:00	120	247	71	252	80	80	.85 .922	3.2	698.202	9
V-2	4:05	123	244	65	249	80	79	1.05 1.025	3.9	704.25	10.5
V-3	4:10	142	244	70	249	81	80	1.1 1.05	4.24	709.24	12
V-4	4:15	147	247	75	248	81	79	1.0	3.56	713.95	12
V-5	4:20	150	244	72	249	83	80	1.1 1.05	4.24	719.43	11.5
V-6	4:25	152	255	69	249	83	81	.9 .949	3.45	725.045	10
	4:30									730.345 32.143	
	60 min	Average 122.8				Average 81.917 Average 81.167	Average 80.917	0.988	Average 3.727	Total 69.934	

EOF

582.8

541.2

70.29

Hg Field Blank Run 6

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\, H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= \qquad \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (\qquad)\ \left(\frac{\qquad \overline{13.6}}{\qquad}\right)$$

$$= \qquad \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

77<

=

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (0.367) + 0.32\ (10.967) + 0.28\ (88.766\ 0) + 0.64\ (\ 0\ )$$

$$.161 \qquad 3.509 \qquad 24.854$$

$= 28.52$ lb/lb-mole

$$M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$$

$$= 28.52\ (1 - 0\ ) + 18\ (\ 0\ )$$

$= 28.52$ lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48 \times 0.811 \times 0.988 \sqrt{\frac{583}{2839 \times 28.52}}$$

$= 58.1$ ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - 0\ )\ (58.1)(12.56)\left(\frac{530}{583}\right)\left(\frac{28.39}{29.92}\right)$$

$$= 2266102 \text{ scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$V_{W,STD} = 0 \text{ ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (69.934)\left(\frac{28.19 + \frac{3.727}{13.6}}{81.167 + 460}\right)$$

$$= 65.144 \text{ ft}^3$$

V_M correction factor 0.995

$= 65.471 \text{ ft}^3$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$B_{wo} = 0$$

5. Concentration of Particulate Matter

$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{72.30}{65.47} (2.205 \times 10^{-6})$	$\frac{72.88}{65.47} (2.205 \times 10^{-6})$	$\frac{90.18}{65.47} (2.205 \times 10^{-6})$
$= 2435 \times 10^{-6}$ lb/ft³	$= 2.4546 \times 10^{-6}$	$= 3.0372 \times 10^{-6}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (2266102)(2435 \times 10^{-6})$	$(2266102)(24546 \times 10^{-6})$	$(2266102)(3.0372 \times 10^{-6})$
$= 5.5180$ lb/hr	$= 5.5623$ lb/hr.	$= 6.8827$ lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(583) \left\{ 0.00267\ (0) + \frac{70.28}{541} \left(2819 + \frac{3.727}{13.6} \right) \right\}}{(60)\ (58.1)(28.39)(0.000341)}$$

$$= 106.5$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right) \left(N\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(1.15 - 0.05)(0.0107)\left(\frac{205}{25}\right)}{65.471}$$

$$= 1.59208 \times 10^{-7}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= 226602 \times 1.592 \times 10^{-7}$$

$$= 0.361\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(N\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(14.70-0.05)(0.1092)\left(\frac{500}{2}\right)}{65.471}$$

$$= 0.000431 \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= 2266102 \times 0.000431$$

$$= 977 \text{ lb/hr.}$$

PLANT Phelps - Dodge Ajo Arizona
LOCATION Acid Plant
STACK DIAMETER (IN.) 48
DUCT DIMENSIONS (IN.) X (IN.)

4,01 DATE 7/27/76
TIME 7 15 Am
RUN # 7

4.02 OPERATORS [illegible], S. Densmore
STATIC PRESSURE (IN.WG.)
4.03 AMBIENT PRESSURE (IN.HG.) 28.20
TYPE S PITOT COEFFICIENT 0.811

STACK PRESSURE (IN.HG.) 28.90
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

METER BOX NUMBER 0009
ORIFICE METER COEFFICIENT 0.678
4.05 PROBE LENGTH (FT.) 5'
NOZZLE DIAMETER (IN.) 1/4"

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
H-1	8 36	103	247	54	253	79	74	.95 .975	3.67	742,822	11.5
H-2	8 41	104	248	46	257	78	75	1.15 1.074	4.44	748.00	14
H-3	8 46	112	247	47	254	78	75	1.1 1.049	4.24	753.68	15
H-4	8 51	117	245	53	253	79	75	.9 0.949	3.45	759.295	12.5
H-5	8 56	120	245	53	250	79	76	.8 0.894	3.1	764.54	9
H 6	9 01	123	252	54	250	80	77	.75 0.866	2.9	769.414	9
	9.06									774.144	
										31.322	
V-1	9 45	124	247	65	250	83	8-	.65 .806	2.5	774.397	8
V-2	9 50	125	248	54	248	83	81	1.0	3.86	778.675	11.5
V-3	9.55	129	247	57	249	84	82	1.05 1.025	4.05	783.97	12.5
V-4	10 00	129	246	63	249	85	84	.85 .922	3.2	787.48	11.5
V-5	10 05	129	251	60	248	85	83	.75 .866	2.9	794.53	8.5
V-6	10 10 10 15	132	250	58	244	85	83	.65 .806	2.5	799.28 803.763	8
										29,366	
	60m	Average 120.6				Average 81.5	Average 79.917	0.936	Average 3.401	Total 60.[illegible]	
						Average [illegible]					

EOF

5806

540.2

60.993

Ajo Acid Plant Run 7

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{lc} \left(\frac{\rho H_2O}{M_{H_2O}}\right) \left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474$$

$$= \quad ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (\quad) \left(\frac{\quad \overline{13.6}}{\quad}\right)$$

$$= \quad ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$=$$

2. Stack Gas Composition

$$M_d = 0.44\,(\%CO_2) + 0.32\,(\%O_2) + 0.28\,(\%N_2 + \%CO)$$

$$+0.64\,(\%SO_2)$$

$$= 0.44\,(0.167) + 0.32\,(13.26) + 0.28\,(86.566 + 0) + 0.64\,(\;0\;)$$

$$0.073 \qquad 4.245 \qquad 24.238$$

= 28.56 lb/lb-mole

$$M_s = M_d\,(1-B_{wo}) + 18\,B_{wo}$$

$$= 28.56\,(1-\;0\;) + 18\,(\;0\;)$$

= 28.56 lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48 \times 0.811 \times 0.936 \sqrt{\frac{581}{28.40 \times 28.56}}$$

= 54.9 ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - 0\ )\ (54.9)(12.56) \left(\frac{530}{581}\right)\left(\frac{28.4}{29.92}\right)$$

$$= 2149418 \text{ scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$V_{w,STD} = 0 \text{ ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (60.688) \left(\frac{28.20 + \frac{3.401}{13.6}}{80.208 + 460}\right)$$

V_m correction factor 0.995

$= 56.604 \text{ ft}^3$

$= 56.888 \text{ ft}^3$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

$B_{wo} = 0$

5. Concentration of Particulate Matter

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$= \frac{1322.47}{56.888} (2.205 \times 10^{-6})$	$\frac{1325.27}{56.888}(2.205 \times 10^{-6})$	$\frac{1931.57}{56.888}(2.205 \times 10^{-6})$
$= 5.1259 \times 10^{-5}$ lb/ft³	$= 5.1368 \times 10^{-5}$	$= 7.4868 \times 10^{-5}$

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

$= (2149418)(5.1259 \times 10^{-5})$	$(2149418)(5.1368 \times 10^{-5})$	$(2149418)(7.4868 \times 10^{-5})$
= 110.1779 lb/hr	= 110.4112 lb/hr.	= 160.9234 lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(531) \left\{ 0.00267 (\quad) + \frac{60.99}{540.2} \left(23.2 + \frac{3.401}{13.6} \right) \right\}}{(60)(54.9)(28.4)(.00341)}$$

$$= 97.5$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(N\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(.95 - .05)(.01331)\left(\frac{240}{25}\right)}{56.39}$$

$$= 2.18 \times 10^{-7}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= 2149418 \times 2.18 \times 10^{-7}$$

$$= .469\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(18.5-.05)(.1092)\left(\frac{555}{3}\right)}{56.89}$$

$$= .000462 \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= 2149410 \times .000462$$

$$= 993 \text{ lb/hr.}$$

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Acid Plant
STACK DIAMETER (IN.) 48
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 2/28/86
TIME 11:39 am
RUN 8

4.02 OPERATORS Sutton

4.03
STATIC PRESSURE (IN.WG.) + 1.35
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.811

STACK PRESSURE (IN.HG.) 28.29
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0009
ORIFICE METER COEFFICIENT 0.678
PROBE LENGTH (FT.) 5
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
V-1	11:39	107	247	62	249	76	77	0.85 .922	3.2	815.760	15
V-2	11:44	116	255	53	247	78	77	1.0	3.86	820.59	21
V-3	11:49	131	253	55	240	77	76	1.0	3.86	825.681	21
V-4	11:54	132	253	61	247	77	77	0.95 .975	3.67	831.16	21
V-5	11:59	130	253	57	247	78	77	0.85 .922	3.2	836.19	20
V-6	12:04 12:09	129	255	56	247	78	77	0.75 .866	2.7	839.19 843.86 / 28.11	19
H-1	12:22	107	250	53	254	76	76	0.8 .894	3.1	844.06	16
H-2	12:27	108	249	53	243	78	75	0.95 .975	3.67	848.80	21
H-3	12:32	117	248	52	243	79	76	1.0	3.86	853.935	21
H-4	12:37	126	250	51	254	78	76	0.8 .894	3.1	858.99	20.5
H-5	12:42	127	247	52	253	78	75	0.75 .866	2.9	863.94	15
H-6	12:47	127	250	54	252	78	75	0.65 .806	2.5	868.67	12.5
	12:52									873.116	29.06
	60 MIN	Average 121.4				Average	Average	.927	Average 3.38	Total 57.17	
						Average 76.9					

EOF

581.4

536.9

$\overline{0.995} = 57.46$

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Acid Plant
STACK DIAMETER (IN.) 48
DUCT DIMENSIONS (IN.) x (IN.)

2,1
DATE 7/28/76
TIME 11:35 am
RUN 8

2,2 OPERATORS Densmore

2,3
STATIC PRESSURE (IN. WG.) +1.35
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.736

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
11:39	3.6	1.3	
11:49	3.6	1.3	
11:59	3.6	1.3	
12.09	3.6	1.3	
12:22	3.7	1.4	
12.32	3.3	1.1	
12.42	3.3	1.1	
12:52	3.3	1.1	

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
0.1	13.9	0
0.1	13.9	0
0.2	13.8	0
Average	Average	Average
0.133	13.87	

EOF
EOF

Acid 8

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{lc} \left(\frac{\rho\, H_2O}{M_{H_2O}}\right) \left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474$$

$$= \qquad ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71 \left(\qquad\right) \left(\frac{\qquad \overline{13.6}}{\qquad}\right)$$

$$= \qquad ft^3$$

$$B_{wo} = \frac{V_{w.std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$=$$

2. Stack Gas Composition

$$M_d = 0.44\,(\%CO_2) + 0.32\,(\%O_2) + 0.28\,(\%N_2 + \%CO)$$

$$+0.64\,(\%SO_2)$$

$$= 0.44\,(.133) + 0.32\,(13.87) + 0.28\,(86 + 0) + 0.64\,(\quad)$$

$$= 28.57 \text{ lb/lb-mole}$$

$$M_s = M_d\,(1-B_{wo}) + 18\,B_{wo}$$

$$= 28.57\,(1-0) + 18\,(0)$$

$$= 28.57 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \times 0.811 \times 0.927 \sqrt{\frac{581.4}{28.29 \times 28.57}}$$

$$= 54.5 \text{ ft/sec}$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1- \qquad)\ (5202)(12.57)\left(\frac{530}{581.4}\right)\left(\frac{28.29}{29.92}\right)$$

$$= 2125722 \text{ scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= \qquad \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (57.46\ \left(\frac{28.19 + \frac{3.30}{13.6}}{536.9}\right)$$

$$= 53.89 \text{ ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$=$

$=$

5. Concentration of Particulate Matter

at 0 sec	1st Reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{14154}{53.89} (2.205 \times 10^{-6})$	$\frac{14238}{53.89} (2.205 \times 10^{-6}$	$\frac{145.93}{53.89} (2.205 \times 10^{-6}$
$= 5.7913 \times 10^{-6}$ lb/ft³	$= 5.8257 \times 10^{-6}$	$= 5.9710 \times 10^{-6}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (2125722)(5.7913 \times 10^{-6})$	$(2,125,722)(5.8257 \times 10^{-6})$	$(2125722)(5.9710 \times 10^{-6})$
$= 12.3108$ lb/hr	$= 12.3839$ lb/hr.	$= 12.6926$ lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{0.00267\ V_{1c} + \frac{V_m}{T_m}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(514)\left\{0.00267\ (0) + \frac{57.46}{536.1}\left(28.19 + \frac{3.30}{13.6}\right)\right\}}{(60)(64.5)(28.79)(.00341)}$$

$$= 93.5$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right)\left(N\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(1.30 - .05)(.0134)\left(\frac{110}{15}\right)}{53.89}$$

$$= 6.335 \times 10^{-7}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= 2125722 \times 6.335 \times 10^{-7}$$

$$= 1.35\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(17.4 - .05)(.1092)\left(\frac{515}{3}\right)}{53.89}$$

$$= 0.000425 \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= 2125722 \times .000425$$

$$= 903 \text{ lb/hr.}$$

No Punch
PLANT Phelps-Dodge, Ajo Arizona
LOCATION Acid Plant
STACK DIAMETER (IN.) 48
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/28/76
TIME 7:19 pm
RUN 9

4.02 OPERATORS Sutton

4.03
STATIC PRESSURE (IN.WG.) + 1.35
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.811

4.07
STACK PRESSURE (IN.HG.) 28.29
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{WO}

4.05
METER BOX NUMBER 0009
ORIFICE METER COEFFICIENT 0.678
PROBE LENGTH (FT.) 5
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
H-1	7:19	106	250	70	250	78	79	0.8 .894	3.1	884.841	11.5
H-2	7:24	108	252	61	255	78	79	0.95 .975	3.67	889.64	17
H-3	7:29	117	249	66	249	78	79	1.0	3.86	894.81	20
H-4	7:34	127	252	67	251	79	79	0.8 .948	3.45	899.99	21.5
H-5	7:39	133	251	67	259	78	79	0.85 .922	3.3	905.11	15
H-6	7:44	137	254	69	252	78	78	0.7 .837	2.7	910.40	13
	7:49									914.586	29.74
V-1	8:23	123	251	73	254	77	77	0.7 .857	2.7	914.852	10
V-2	8:28	138	253	68	252	77	78	0.85 .922	3.2	919.26	13
V-3	8:33	143	259	73	260	79	80	0.9 .948	3.45	924.18	16.5
V-4	8:38	158	252	77	255	79	80	0.8 .894	3.1	929.20	15
V-5	8:43	159	250	76	250	78	79	0.75 .866	2.9	934.16	14
V-6	8:48	162	252	77	253	79	80	0.70 .851	2.7	938.88	12
	8:53									943.451	28.6
		Average 133.4				Average	Average Average 78.5	0.907	Average 3.17	Total 58.34	

EOF

593.4

538.5

58.34 / 0.995 = 58.63

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Acid Plant
STACK DIAMETER (IN.) 48
DUCT DIMENSIONS (IN.) x (IN.)

2,1
DATE 7/28/76
TIME 7:19 pm
RUN 9

2,2 OPERATORS Densmore

2,3
STATIC PRESSURE (IN. WG.) 1.35
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.736

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
0.1	12.9	0
0.2	12.8	0
0.2	12.8	0
Average	Average	Average
0.167		0

EOF
EOF

Accd. 9

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= \qquad ft^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (\qquad)\ \left(\frac{\qquad\quad \overline{13.6}}{}\right)$$

$$= \qquad ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$=$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (.167) + 0.32\ (12.8) + 0.28\ (87 + 0) + 0.64\ (\quad)$$

$= 28.53$ lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.53\ (1-0) + 18\ (0)$$

$= 28.53$ lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \times 0.811 \times 0.907 \sqrt{\frac{593.4}{28.29 \times 28.53}}$$

$= 53.9$ ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1- 0\ )\ 53.9)(1257)\left(\frac{530}{593.4}\right)\left(\frac{28.29}{29.92}\right)$$

$= 2059806$ scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\, H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$= \qquad ft^3$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (58.63\ )\left(\frac{28.19 + \frac{3.17}{13.6}}{5385}\right)$$

$= 54.80\ ft^3$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 0 sec.	1st reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{95.77}{54.53} (2.205 \times 10^{-6})$	$\frac{97.12}{54.53} (2.205 \times 10^{-6})$	$\frac{129.74}{54.53} (2.205 \times 10^{-6})$
$= 3.8726 \times 10^{-6}$ lb/ft³	$= 3.9272 \times 10^{-6}$ lb/ft³	$= 5.2462 \times 10^{-6}$ lb/ft³

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$

$= (2059806)(38726 \times 10^{-6})$	$(2059806)(3.9272 \times 10^{-6})$	$(2059806)(5.2462 \times 10^{-6})$
= 7.9768 lb/hr	= 8.0892 lb/hr.	= 10.8662 lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(593.4) \left\{ 0.00267\ (\ 0\ ) + \frac{58.63}{538.5} \left(28.19 + \frac{3.17}{13.6} \right) \right\}}{(60)\ (53.9)(28.29)(0.000341\ )}$$

$$= 98.1$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(\ 5.55 - .05\ )(.01331)\left(\frac{175}{25}\right)}{54.80}$$

$$= 1.0091 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= 2059806 \times 1.0091 \times 10^{-6}$$

$$= 2.08\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(9.10-.05)(.1092)\left(\frac{620}{3}\right)}{54\ 80}$$

$$= 0.0002263 \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= 2059806 \quad X .000263$$

$$= 541.7 \text{ lb/hr.}$$

Reverb ESP Outlet

0,0 PLANT Phelps Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet

0,1 STACK DIAMETER (IN.) 72

0,2 DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 DATE 7/20/76
TIME 4:15 PM
RUN #1

1,2 OPERATORS Gilchrist

1,3 STATIC PRESSURE (IN. WG.) -24
AMBIENT PRESSURE (IN. HG.) 28.25
TYPE S PITOT COEFFICIENT 0.774

10F

1,4 WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	400	0	398.4
Initial	350	0	381.8
Liquid Collected	50	0	16.6
			Total, V_{lc}
			66.6

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
4:15	296.586	1.0	103	103	1.3	637
4:20	299.480	1.0	105	104	1.3	635
4:25	302.250	1.0	104	103	1.3	632
4:30	304.780	0.98	101	102	1.1	631
4:35	307.400	0.955	101	102	1.0	625
4:48	307.400	1.0	101	101	1.3	624
4:58	309.880	1.0	103	102	1.3	627
5:03	312.450	1.0	104	104	1.3	627
5:08	314.408	0.89	104	105	1.2	620

Total, V_m	Average	Avg., T_m
17.822	0.978	102.889

EOF
EOF

$\frac{V_M}{1.012} = 17.611$

+460
= 562.889

No Punch
PLANT *Phelps-Dodge, Ajo Arizona*
LOCATION *Reverb ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) x (IN.)

2,1
DATE *7/20/76*
TIME *4:15 pm*
RUN *#1*

2,2 OPERATORS *Gilchrist*

2,3
STATIC PRESSURE (IN. WG.) *- 2.4*
AMBIENT PRESSURE (IN. HG.) *28.23*
TYPE S PITOT COEFFICIENT *0.774*

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
4:15	3.0	1.3	637
4:20	3.0	1.3	635
4:25	3.0	1.3	632
4:30	2.94	1.1	631
4:35	2.80	1.0	625
4:53	3.0	1.3	624
4:58	3.0	1.3	627
5:03	3.0	1.3	627
5:08	3.07	1.2	620

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
1.0	18.1	0
1.0	18.1	0
1.0	18.1	0
Average	Average	Average
1.0	18.1	0

EOF
EOF

* *data from test #2.*

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/20/76
TIME 4:15 pm
RUN 1

4.02 OPERATORS Knrick

4.03
STATIC PRESSURE (IN.WG.) - 2.4
AMBIENT PRESSURE (IN.HG.) 28.23
TYPE S PITOT COEFFICIENT 0.784

STACK PRESSURE (IN.HG.) 28.05
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{WO}

4.05
METER BOX NUMBER 0015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp		Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
						Inlet (°F)	Outlet (°F)				
A-1	4:15									503.127	5
A-2								0.9	0.4	504.000	5
A-3											5
A-4	4:20									504.92	5
A-5		595	210	68	248	79	82	1.1		505.32	5
A-6		602	218	67	248	79	82	1.0	1.05	505.77	5
A-7	4:25	600	223	62	249	79	82	1.1	1.8	506.65	5
A-8		600	223	62	249	79	82	1.1	1.8	507.74	5
A-9		597	216	62	248	79	82	1.0	1.7	508.62	5
A-10	4:30	599	224	62	252	80	82	1.0	1.8	510.24	5
A-11		584	217	63	249	80	83	1.0	1.8	511.48	5
A-12		579	222	64	251	80	83	1.0	1.8	512.8	5
A-13	4:35	557	220	65	253	81	83	1.0	1.8	514.25	5
A-14		567	219	66	249	80	83	1.0	1.8	515.38	5
A-15		575	218	68	249	80	83	1.2	1.8	516.35	5
A-16	4:40	553	214	68	250	81	82	1.5	2.5	517.83	5
A-17		560						0.2	0.5	519.20	5
A-18	4:45	575	224	70	249	80	82	0.8	1.5	520.22	5
										521.20	
		Average —				Average — Average —	Average —		Average —	Total [illegible]	

EOF :30

No Punch
PLANT *Phelps-Dodge, Ajo Arizona*
LOCATION *Reverb ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE *7/20/76*
TIME *4:58 pm*
RUN *1*

4,02 OPERATORS *Knirck*

4,03
STATIC PRESSURE (IN.WG.) *-2.4*
AMBIENT PRESSURE (IN.HG.) *26.23*
TYPE S PITOT COEFFICIENT *0.784*

4,07
STACK PRESSURE (IN.HG.) *26.05*
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER *0015*
ORIFICE METER COEFFICIENT *0.681*
PROBE LENGTH (FT.) *10*
NOZZLE DIAMETER (IN.) *0.25*

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-1	4:58	152	209	71	250	80	82	0.5	0.75	521.28	
B-2		232	211	69	248	80	82	0.6	0.80	522.32	
B-3		592	219	68	249	82	82	0.7	1.50	523.14	
B-4	5:03	592	218	66	251	80	82	0.9	1.70	524.55	
B-5		591	216	66	250	80	82	1.0	1.70	525.36	
B-6		590	215	68	250	80	82	1.0	1.60	526.59	
B-7	5:08	588	220	70	249	80	82	1.2	1.90	527.86	
B-8		569	215	73	250	80	82	1.1	1.60	52[illegible].10	
B-9		590	213	74	249	80	82	1.0	1.70	5[illegible]4.09	
B-10	5:13	586	222	75	252	81	83	1.0	1.70	5[illegible].21	
B-11		585	218	75	251	81	83	1.0	1.70	5[illegible]1.50	
B-12		571	219	71	250	82	82	1.3	1.90	530.28	
B-13	5:18	569	216	72	251	81	82	1.2	1.80	531.51	
B-14		568	214	72	251	81	82	1.1	1.80	532.75	
B-15		567	216	72	246	81	82	1.05	1.80	534.02	
B-16	5:23	565	216	72	250	81	82	1.0	1.80	535.27	
B-17		560	216	73	251	81	82	1.0	1.80	536.50	
B-18		584	219	73	251	80	82	1.0	1.80	537.74	
	5:28					Average	Average			542.63	
		Average				80.260	[illegible]		Average	Total	
		557.688				Average	81.24		[illegible]	[illegible]	

EOF

+460
=1017.688

+460
=541.24

$(\sqrt{\Delta P})_{avg.}$
= .9842

$\frac{V_m}{1.002}$ 39.423 = 39.344

AJO, Reverb ESP
RUN. 1 9/20/76

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (66.60)$$

$$= 3.1568\ \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (17.611)\left(\frac{28.23 + \frac{.978}{13.6}}{562.889}\right)$$

$$= 15.682\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{3.1568}{3.1568 + 15.682}$$

$$= 0.1676$$

2. Stack Gas Composition

$$M_d = 0.44\,(\%CO_2) + 0.32\,(\%O_2) + 0.28\,(\%N_2 + \%CO)$$

$$+0.64\,(\%SO_2)$$

$$= 0.44\,(1.0) + 0.32\,(18.1) + 0.28\,(81.9 + 0) + 0.64\,(\quad)$$

$$= 29.1640 \text{ lb/lb-mole}$$

$$M_s = M_d\,(1-B_{wo}) + 18\,B_{wo}$$

$$= 29.1640\,(1-.1676) + 18\,(.1676)$$

$$= 27.2929 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48 \times .784 \times .9892 \cdot \sqrt{\frac{1017.688}{(28.05)(27.2929)}}$$

$$= 76.046 \text{ ft/sec}$$

$$A = \frac{\pi(72)^2}{(4)(144)}$$

$$= 28.2743$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .1676)\ (76.044)(28.2743)\left(\frac{530}{1017.688}\right)\left(\frac{28.05}{29.92}\right)$$

$$= 3{,}145855 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= \qquad \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (39.344)\left(\frac{28.23 + \frac{1.619}{13.6}}{541.24}\right)$$

$$= 36.496 \quad \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 0 sec.	1st reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{1727.21}{36.496} (2.205 \times 10^{-6})$	$\frac{1728.99}{36.496} (2.205 \times 10^{-6})$	$\frac{2207.09}{36.496} (2.205 \times 10^{-6})$
$= 1.0435 \times 10^{-4}$ lb/ft³	$= 1.0446 \times 10^{-4}$	$= 1.3335 \times 10^{-4}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (3,145,855)(1.0435 \times 10^{-4})$	$= (3,145,855)(1.0446 \times 10^{-4})$	$= (3,145,855)(1.3335 \times 10^{-4})$
$= 328.282$ lb/hr	$= 328.6204$ lb/hr.	$= 419.4904$ lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6}\right)\right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\overset{1017.688}{\quad}) \left\{0.00267\ (66.6) + \frac{39.344}{541.24} \left(28.23 + \frac{1.619}{13.6}\right)\right\}}{(60)\ (76.0448)(28.05)(3.4088 \times 10^{-4})}$$

$$= 87.0479$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(34.90 - .05)(.0130)\left(\frac{250}{100}\right)}{36.496}$$

$$= 3.3517 \times 10^{-6}\ lb/ft^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (3,145,855)\ (3.3517 \times 10^{-6})$$

$$= 10.544\ lb/hr$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{(V_t - V_{tb})\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(20.90 - .05)(.1115)\left(\frac{360}{1}\right)}{36.446}$$

$$= 1.6012 \times 10^{-3} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (3,145,855)(1.6012 \times 10^{-3})$$

$$= 5.037 \times 10^{3} \text{ lb/hr.}$$

No Punch
PLANT PHELP DODGE AJO ARIZONA
LOCATION REVERB ESP OUTLET
STACK DIAMETER (IN.) 72"
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/21/76
TIME 5:25 PM
RUN # 2A

4,02 OPERATORS F.N. RCL

4,03
STATIC PRESSURE (IN.HG.) −2.4
AMBIENT PRESSURE (IN.HG.) 28.16
TYPE S PITOT COEFFICIENT 0.784

STACK PRESSURE (IN.HG.) 27.98
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4,08

		Ts				Tm		ΔP	ΔH	Vm	
Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	5:25	278	205		258	78	80	.8 .89	1.5	545.336	8
A-2		217	209		258	78	80	.4 .99	1.6	546.450	10
A-3		524	204		257	78	80	1.1 1.05	1.9	547.720	11
A-4	5:30	546	198		258	78	80	1.3 1.14	2.3	549.465	12
A-5		514	206		258	78	80	1.3	2.3	550.215	13
A-6		513	200		258	78	80	1.2 1.095	2.2	551.565	16
A-7	5:35	518	198		258	78	80	1.3 1.14	2.3	552.445	16
A-8		519	198		258	78	80	1.3	2.3	554.320	17
A-9		513	197		258	78	80	1.2 1.095	2.3	555.732	16
A-10	5:40	521	197		258	78	80	1.2	2.3	557.125	16
A-11		514	211		244	78	80	1.2	2.3	558.550	16
A-12		512	200		259	78	80	1.2	2.3	559.765	15
A-13	5:45	520	240		258	78	80	1.2	2.3	561.392	14
A-14		518	220		258	78	80	1.1 1.05	2.0	562.755	14
A-15		518	221		259	78	80	1.2 1.095	2.1	564.115	13
A-16	5:50	518	227		260	78	80	1.2	2.1	565.435	13
A-17		518	245		260	78	80	1.1 1.05	2.1	566.780	13
A-18		519	241		259	78	80	1.0	2.0	568.128	13
	5:55									569.465	
		Average 537.6				Average 78 Average [illegible]	Average 80	1.073	Average 2.12	Total [illegible]	

EOF

$\overline{A1B} = 537.6$
$+460$
997.6

$\overline{A1B} = 78.9$
$+460$
538.9

$\overline{A1B} = 2.115$

$\overline{A1B} = 1.068$

$V_m = 24.13 + 24.11 = 48.24$

$\frac{V_m}{1.002} = 48.1437$

No Punch
PLANT PHELPS DODGE AJO ARIZONA
LOCATION REVERB ESP OUTLET
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/21/76
TIME 6:00 PM
RUN # 2B

4.02 OPERATORS

4.03
STATIC PRESSURE (IN.HG.)
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT

4.07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER
ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-1	6:00	[illegible]	233		258	77	74	.949	[illegible]	[illegible]	
B-2		561	238		260	77	74	[illegible]	[illegible]	[illegible]	
B-3		568	23[illegible]		266	77	74	1.05	[illegible]	[illegible]	
B-4	6:05	566	231		260	77	74	1.095	[illegible]	[illegible]	
B-5		566	241		254	77	74	1.05	[illegible]	[illegible]	
B-6		572	236		254	78	74	1.14			[illegible]
B-7	6:10	572	242		260	77	78		[illegible]	[illegible]	
B-8		574	234		261	77	78	1.183	[illegible]	[illegible]	
B-9		578	232		261	77	78		[illegible]	[illegible]	9
B-10	6:15	586	242		260	78	78		[illegible]		8
B-11		591	245		260	78	78		[illegible]	[illegible]	
B-12		592	234		260	77	78	1.095	[illegible]	[illegible]	
B-13	6:20	592	237		261	78	78		[illegible]	[illegible]	
B-14		592	246		259	78	78	1.05	[illegible]	[illegible]	6
B-15		593	245		259	77	78		[illegible]	[illegible]	5
B-16	6:25	575	236		260	77	78		[illegible]	[illegible]	16
B-17		235	237		260	77	78	.949	[illegible]	[illegible]	14
B-18		205	233		260	77	78	.775	[illegible]	[illegible]	12
	6:30										8
		Average 581.6				Average	Average				
						Average 77.8		1.062	Average 2.11	Total 29.1	

EOF

0.0 [PLANT Phelps - Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet

0.1 [STACK DIAMETER (IN.) 72

0.2 [DUCT DIMENSIONS (IN.) x (IN.)

1.0

1.1 [DATE 7/21/76
TIME 5:23 pm
RUN 2

1.2 [OPERATORS Gilchrist

1.3 [STATIC PRESSURE (IN. WG.) - 2.4
AMBIENT PRESSURE (IN. HG.) 28.16
TYPE S PITOT COEFFICIENT 0.774

EOF

1.4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1.5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	415	340	402.6
Initial	350	350	382.0
Liquid Collected	65	- 10	20.6
			Total, W_w
			75.6

EOF

1.6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh) ΔH	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
5:23	314.71	1.6	94	93	1.4	609
5:28	317.46	1.5	93	93	1.3	606
5:33	320.45	1.5	93	93	1.3	610
5:38	322.22	1.5	92	92	1.3	611
6:18	323.22	1.5	90	91	1.3	612
	326.11	1.2	89	90	1.3	612
	329.16	1.1	90	90	1.2	611
	330.01	0.9	89	89	1.2	612
	334.54	0.9	89	87	1.3	612
	337.315	1.0	89	89	1.3	611
	340.255	1.0	89	89	1.2	611
	343.185	1.0	89	89	1.2	611

Total, V_m	Average	Avg., T_m
28.48	1.225	90.5

550.5

EOF
EOF

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) x (IN.)

2,1 DATE 7/21/76
TIME 5:23 pm
RUN 2

2,2 OPERATORS Gilchrist

2,3 STATIC PRESSURE (IN. WG.) - 2.4
AMBIENT PRESSURE (IN. HG.) 28.16
TYPE S PITOT COEFFICIENT 0.774

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
5:23	3.9	1.4	604
5:28	3.6	1.3	606
5:33	3.6	1.3	610
5:38	3.6	1.3	611
6:18	3.6	1.3	612
	3.6	1.3	613
	3.4	1.2	611
	3.4	1.2	612
	3.6	1.3	612
	3.6	1.3	611
	3.6	1.3	611
	3.6	1.3	611

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
1.0	18.1	0
1.0	18.1	0
1.0	18.1	0
Average	Average	Average
1.0	18.1	0

EOF
EOF

Phelps-Dodge
7/21/76 Run 2

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (75.6)$$

$$= 3.58\ \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ \left(\frac{28.18}{1.012}\right)\left(\frac{28.16 + \frac{1.225}{13.6}}{550.5}\right)$$

$$= 25.5765\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{3.58}{3.58 + 25.5765}$$

$$= .1228$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO) + 0.64\ (\%SO_2)$$

$$= 0.44\ (1.0) + 0.32\ (18.1) + 0.28\ (80.9 + 0) + 0.64\ (0)$$

= 28.88 lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.88\ (1-.1228) + 18\ (.1228)$$

= 27.5439 lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48\ X .784\ X 1.068 \sqrt{\frac{971.6}{27.98 \times 27.5439}}$$

= 81.432 ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right) \left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .1228)\ (81.432)(28.2743 \left(\frac{530}{997.6}\right) \left(\frac{27.98}{29.92}\right)$$

$= 3,612,381.728$ scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right) \left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$= \qquad$ ft³

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ \frac{(48.24)}{1.002} \left(\frac{28.16 + \frac{2.115}{13.6}}{(538.4)}\right)$$

$= 44.8412$ ft³

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 0 sec.	1st reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{1791.26}{44.8412} (2.205 \times 10^{-6})$	$\frac{1792.67}{44.8412}(2.205 \times 10^{-6}$	$\frac{2184.87}{44.8412}(2.205 \times 10^{-6})$
$= 8.8083 \times 10^{-5}$ lb/ft³	$= 8\ 81519 \times 10^{-5}$	$= 1.0744 \times 10^{-4}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (3{,}612{,}382)(8.8083 \times 10^{-5})$	$(3{,}612{,}382)(8\ 8159 \times 10^{-5}$	$(612{,}382)(1.0744 \times 10^{-4})$
$= 318.1879$ lb/hr	$= 318.4384$ lb/hr.	

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\overset{997.6}{\quad}) \left\{ 0.00267\ (75.6) + \frac{48.1437}{538.4} \left(28.16 + \frac{2.115}{13.6} \right) \right\}}{(60)\ (81.430)(27.98)(3.4088 \times 10^{-4})}$$

$= 91.37d$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb} \right) \left(\underline{N} \right) \left(\frac{V_{soln}}{V_a} \right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(87.80 - 0.05)(0.0130)\left(\frac{375}{100} \right)}{44.8412}$$

$= 1.0303 \times 10^{-5}$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$= (3{,}612{,}381.728)(1.0303 \times 10^{-5})$

$= 37.2188$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(28.75-0.05)(0.1115)\left(\frac{520}{1}\right)}{44.8412}$$

$$= 2.6162 \times 10^{-3} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (3{,}612{,}381{,}728)(2.6162 \times 10^{-3})$$

$$= 9.4501 \times 10^{-3} \text{ lb/hr.}$$

No Punch

PLANT Phelps - Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/22/76
TIME 9:56 am
RUN 3

4,02 OPERATORS Knirck

4,03
STATIC PRESSURE (IN.WG.) -2.4
AMBIENT PRESSURE (IN.HG.) 28.18
TYPE S PITOT COEFFICIENT 0.784

4,07
STACK PRESSURE (IN.HG.) 28.00
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	9:56	220	245		273	79	80	0.6	0.9	596.212	3
A-2		220	246		272	79	79	0.8	1.1	597.115	3
A-3		536	233		263	78	79	0.8	1.5	598.130	4
A-4	10:01	596	243		258	78	80	0.9	1.6	599.255	5
A-5		611	245		259	79	79	1.0	1.8	600.442	6
A-6		613	248		263	79	79	1.0	1.8	601.72	6
A-7	10:06	611	245		264	79	79	1.1	2.0	602.945	6.5
A-8		609	238		264	79	79	1.1	2.0	604.245	6.5
A-9		607	235		264	79	79	1.2	2.2	605.560	6.5
A-10	10:11	598	244		264	79	79	1.2	2.2	606.885	7
A-11		590	247		264	79	79	1.25	2.2	608.240	7
A-12		586	245		265	80	79	1.2	2.2	609.530	7
A-13	10:16	585	235		264	79	79	1.2	2.2	611.00	7
A-14		582	243		263	80	80	1.2	2.2	612.375	7
A-15		582	245		263	80	80	1.2	2.2	613.745	7
A-16	10:21	581	238		263	80	80	1.2	2.2	615.10	7
A-17		581	248		263	80	80	1.2	2.2	616.438	7
A-18		581	237		263	80	80	1.2	2.2	617.790	7
	10:26									619.145	
		Average				Average	Average		Average	Total	
		—					—		—	22.933	
						Average	—				

EOF

8 Punch

PLANT *Phelps-Dodge, Ajo Arizona*
LOCATION *Reverb ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE *7/22/76*
TIME *10:29 am*
RUN *3*

4.02 OPERATORS

4.03
STATIC PRESSURE (IN.WG.)
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT

4.07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER
ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
8-18	10:29	570	235		261	80	80	0.6	1.1	519.145	4
8-17		576	244		261	80	80	0.8	1.4	520.10	4
8-16		576	236		262	80	80	0.9	1.6	521.175	5
8-15	10:34	577	240		266	80	80	0.9	1.6	522.328	5
8-14		577	238		262	80	80	1.0	1.8	523 48[illegible]	6
8-13		578	245		260	80	80	1.0	1.8	524.74	6
8-12	10:39	580	240		262	80	80	1.1	2.0	525.475	7
8-11		583	234		262	80	80	1.1	2.1	527.252	7
8-10		589	239		263	80	80	1.2	2.2	528.615	7
8-9	10:44	598	234		263	81	80	1.1	2.0	529.96	8
8-8		600	240		262	81	80	1.1	2.0	531.27	8
8-7		600	240		262	81	80	1.0	1.8	532.58	7
8-6	10:49	600	242		262	81	80	0.9	1.6	535.835	5
8-5		600	242		264	81	80	0.9	1.6	535.015	5
8-4		600	242		262	81	80	0.9	1.8	536.212	5
8-3	10:54	580	232		260	81	80	0.8	1.5	531.905	5
8-2		215	240		260	81	80	0.75	1.4	538.54	5
8-1		147	246		263	80	80	0.6	1.1	539.68	4
	10:59									540.720	
		Average 545.417				Average [illegible] Average	Average [illegible] [illegible]		Average [illegible]	Total 21.575	

EOF

+460
=1005.417

+460
=539.7639

$(\sqrt{\Delta P})_{avg}$
$= .8954$

22.933 + 21.575
= 44.508

$\frac{V_M}{1.002} = 44\ 419$

No Punch
PLANT Phelps - Dodge Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 70
DUCT DIMENSIONS (IN.) x (IN.)

2.1
DATE 7/22/76
TIME 9:57 am
RUN 3

2.2 OPERATORS Gilchrist

2.3
STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.18
TYPE S PITOT COEFFICIENT 0 774

STACK GAS MOLECULAR WEIGHT

2.5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F) Bottle	
9:57	3	1.2	90	625
10:02	3	1.2	90	626
10:07	3	1.2	89	624
10:45	3	1.2	93	592
10:50	3	1.1	9.3	623
10:55	3.1	1.3	9.5	622
11:00	3.1	1.09	92	620
11:05	3	1.1		
11:10	3	1.2	93	620
11:15	3	1.2	91	621
11:20	3	1.0	91	619
11:25	>	1.2	91	620
11:30	3.2	1.2	91	620
11:35	3.1	1.0	92	619
11:40	2.5	1.0	92	624
11:45	3.0	1.0	91	623

EOF

2.6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
3.7	11.3	0
3.8	11.2	0
3.7	11.3	0
Average	Average	Average
3.733	11.267	0

EOF
EOF

11:50	3	1.0	91	624
11.55	3	1.2	91	625
12:00	3	1.1	90	622

* no moisture data ; use data from test #2.

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{lc} \left(\frac{\rho H_2O}{M_{H_2O}}\right) \left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474$$

$$= \qquad ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (\qquad) \left(\frac{\qquad 13.6}{\qquad}\right)$$

$$= \qquad ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

= 0.1228 (from Run # 2)

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (3.733) + 0.32\ (11.267) + 0.28\ (85.0 + 0) + 0.64\ (\quad)$$

$$= 29.048 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 29.048\ (1-0.1228 + 18\ (0.1228)$$

$$= 28.0703 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \times 0.784 \times 0.8954 \sqrt{\frac{1005.417}{(28.00)(28.0703)}}$$

$$= 67.8685 \text{ ft/sec}$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1-0.1228)\ (67.8645)(28.274) \left(\frac{530}{1005.417}\right)\left(\frac{28.00}{29.92}\right)$$

$$= 2{,}989{,}390.952 \text{ scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\, H_2O}{M_{H_2O}}\right)\left(\frac{R\, T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= \qquad \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (44.419) \left(\frac{28.18 + \frac{1.808}{13.6}}{539.764}\right)$$

$$= 41.2637 \text{ ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 0 sec.	1st Reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{1708.32}{41.2637} (2.205 \times 10^{-6})$	$\frac{1710.42}{41.2637} (2.205 \times 10^{-6})$	$\frac{2140.05}{41.2637} (2205 \times 10^{-6})$
$= 9.1287 \times 10^{-5}$ lb/ft³	$= 9.1399 \times 10^{-5}$	$= 1.1436 \times 10^{-4}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (2,989,391)(9.1287 \times 10^{-5})$	$(2989391)(9.1399 \times 10^{-5})$	$(2989391)(1.1436 \times 10^{-4})$
$= 272.930$ lb/hr	$= 273.2284$ lb/hr	$= 341.8590$ lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{0 V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(1008.417)\left\{ 0.00267\ (95.6) + \frac{44.419}{539.764} \left(28.18 + \frac{1.808}{13.6} \right) \right\}}{(60)\ (69.885)(28.00)(34088 \times 10^{-4})}$$

$$= 1.0418 \times 10^{2}$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(52.65 - .05)(.0109)\left(\frac{582}{100}\right)}{41.2639}$$

$$= 5.6291 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (2,484,390.452)(5.6291 \times 10^{-6})$$

$$= 16.8216\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(9.50 - .05)(.1011)\left(\frac{680}{1}\right)}{41.2039}$$

$$= 1.1166 \times 10^{-3} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (2,489,296.95)(1.1166 \times 10^{-3})$$

$= [illegible] \times 10^{3}$ lb/hr.

No Punch

PLANT *Phelps - Dodge, Ajo Arizona*
LOCATION *Reverb ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE *7/23/76*
TIME *9:18 am*
RUN *4*

4.02 OPERATORS *Knirck*

4.03
STATIC PRESSURE (IN.WG.) *-2.4*
AMBIENT PRESSURE (IN.HG.) *28.26*
TYPE S PITOT COEFFICIENT *0.784*

STACK PRESSURE (IN.HG.) *28.08*

4.07 MOLECULAR WEIGHT (LB/LB-MOLE)

B_{wo}

4.05
METER BOX NUMBER *0015*
ORIFICE METER COEFFICIENT *0.681*
PROBE LENGTH (FT.) *10*
NOZZLE DIAMETER (IN.) *0.25*

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-18	8:53	564	236	66	238	77	77	0.8	1.5	674.49	4
B-17		565	236	66	238	77	77	1.0	1.8	676.00	6
B-16		565	256	65	236	77	77	1.1	2.0	676.74	6
B-15	8:58	564	237	66	237	78	77	1.1	2.0	678.035	6
B-14		564	239	66	237	78	77	1.2	2.2	679.33	7
B-13		565	248	66	238	78	77	1.3	2.3	680.64	8
B-12	9:03	566	236	67	237	78	77	1.3	2.3	682.10	8
B-11		568	240	67	237	78	77	1.4	2.5	683.225	8
B-10		573	245	67	238	79	77	1.4	2.5	684.931	8
B-9	9:08	590	240	68	236	79	76	1.4	2.4	686.365	8
B-8		592	239	68	237	79	77	1.4	2.4	687.825	8
B-7		590	240	69	237	79	77	1.3	2.3	689.255	8
B-6	9:13	591	242	69	234	79	77	1.2	2.2	690.655	7
B-5		591	247	70	234	79	77	1.15	2.1	692.005	7
B-4		591	247	69	236	79	77	1.1	2.1	693.375	7
B-3	9:18	583	237	70	237	79	77	1.05	1.95	694.700	7
B-2		306	247	70	236	79	77	0.9	1.7	695.975	6
B-1		140	242	70	234	79	77	0.7	1.2	697.21	4
	9:23									698.25	
		Average				Average	Average		Average	Total	
		[illegible]28.917				[illegible]	[illegible]		2.25	23.760	
						Average [illegible]					

EOF

+460
θ = 60 min = 988.917

+460
= 539.364

$(\sqrt{\Delta P})_{avg}$
= 1.1115

23.545 + 23.760
= 47.305

$\frac{V_m}{1000}$ = 47.211

No Punch

PLANT Phelps-Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/23/76
TIME 9:18 am
RUN 4

4,02
OPERATORS

4,03
STATIC PRESSURE (IN.WG.)
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT 0.784

4,07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{WO}

4,05
METER BOX NUMBER
ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	9:18	186	235	69	225	76	77	0.7	1.2	650.945	4
A-2		260	231	66	229	76	77	1.0	1.8	652.08	5
A-3		540	246	64	251	77	77	1.2	2.2	653.215	6
A-4	9:23	602	245	62	257	77	77	1.3	2.3	654.538	7
A-5		611	235	62	255	77	77	1.3	2.3	655.92	7
A-6		611	244	62	248	77	77	1.4	2.4	657.34	7
A-7	9:28	612	247	62	244	77	77	1.4	2.4	658.752	7
A-8		610	243	62	238	77	77	1.4	2.4	660.165	7
A-9		605	245	62	238	77	77	1.4	2.45	661.60	8
A-10	9:33	588	238	61	232	77	77	1.5	2.7	663.065	8
A-11		584	235	61	237	78	77	1.5	2.7	664.52	9
A-12		582	248	61	241	77	77	1.5	2.7	666.025	9
A-13	9:38	579	243	61	239	78	77	1.5	2.7	667.535	9
A-14		576	234	61	235	78	77	1.4	2.6	669.02	9
A-15		565	245	63	237	77	77	1.4	2.6	670.52	9
A-16	9:43	567	245	64	241	78	77	2.0	3.6	671.09	12
A-17		340	234	67	241	77	77	2.0	3.6	675.51	6
A-18		355	239	67	235	77	77	0.5	0.9	673.70	4
	9:48	Average				Average	Average			674.49	
		—				—	—		Average	Total	
						Average	—		—	23.545	

EOF

No Punch
PLANT Phelps - Dodge, Ajo Arigona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) x (IN.)

2,1 DATE 7/23/76
TIME 9:18 am
RUN 4

2,2 OPERATORS Gilchrist

2,3 STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.25
TYPE S PITOT COEFFICIENT 0.774

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)	
			Bottle	
9:18	25	1.3	91	622
9:23	25	1.5	99	625
9:28	25	1.5	96	629
9:33	25	1.5	95	628
10:08	25	1.5	98	611
10:13	25	1.5	96	619
10.18	25	1.5	93	614
10:23	25	1.3	93	622
10:28	25	1.3	92	617
10:33	25	1.5	92	616
10:38	25	1.4	92	612
10.43	25	1.3	92	612

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
0.8	18.2	0.1
0.9	18.1	0
0.9	18.0	0
Average	Average	Average
.867	18.1	.033

EOF
EOF

* no moisture data; use data for test #2.

ASO . REVERB ESP
RUN 4
7/23/76

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho H_2O}{M_{H_2O}}\right) \left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= \quad \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71 \left(\quad \right) \left(\frac{\quad \frac{\quad}{13.6}}{\quad}\right)$$

$$= \quad \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

= .1228 (from #2)

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (.867) + 0.32\ (18.1) + 0.28\ (81.03 + 0) + 0.64\ (0)$$

= 28.863 lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.865\ (1-.1228) + 18\ (.1228)$$

= 29.529 lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_pC_p\left(\sqrt{\Delta P}\right)_{avg}\sqrt{\frac{T_{s,avg}}{P_sM_s}}$$

$$= 85.48 \text{ X } .784 \text{ X } 1.1115 \sqrt{\frac{[illegible]}{(28.04)(29.529)}}$$

= 88.2512 ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .1228)\ (44.2512)(26.2743) \left(\frac{530}{988.917}\right)\left(\frac{28.08}{29.92}\right)$$

$$= 3{,}918{,}934 \text{ scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= \quad \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (49.211) \left(\frac{28.26 + \frac{2.25}{13.6}}{539.361}\right)$$

$$= 44.2286 \text{ ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 0 sec.

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$$= \frac{1145.86}{[illegible].8826} (2.205 \times 10^{-6})$$

$= 5.7126 \times 10^{-5}$ lb/ft³

[illegible] = 5.9211 × 10^-5

= 2.9442 × 10^-5

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

$= (3,783,734)(5.7126 \times 10^{-5})$

= 216.1512 lb/hr

(3,924,734)(5.92[illegible]) [illegible]

= 216.4718 lb/hr

= [illegible] lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\, T_s \left\{ 0.00267\, V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\theta V_s\, P_s\, A_n}$$

$$= \frac{(1.667)(482.917) \left\{ 0.00267\,(75.6) + \frac{47.211}{539.361} \left(28.26 + \frac{2.25}{13.6} \right) \right\}}{(60)\,(84.2514)(28.08)(3.4088 \times 10^{-4})}$$

$= 91.9622$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(7.20 - .05)(.0107)\left(\frac{330}{100}\right)}{44.2286}$$

$= 6.1649 \times 10^{-7}$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$ER = Q_s\, C_{H_2SO_4}$

$= (3,783,134)(6.1649 \times 10^{-7})$

$= 2.3326$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(12.80 - .05)(.1017)\left(\frac{510}{1}\right)}{44.2286}$$

$$= 1.0541 \times 10^{-3} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (3,283,184)(1.0541 \times 10^{-3})$$

= 3.4[illegible] $\times 10^{3}$ lb/hr.

0,0 [PLANT Phelps - Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet

0,1 [STACK DIAMETER (IN.) 72

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/26/76
TIME 8:50 am
RUN 5

1,2 [OPERATORS Gilchrist

1,3 [STATIC PRESSURE (IN. WG.) - 2.4
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.774

1OF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final			
Initial			
Liquid Collected			
			Total, V_{lc}
			27.7

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
8:50	343.37	0.75	92	89	1.0	602
	346.06	0.80	92	90	1.1	604
	347.791	0.50	103	91	1.1	611
	349.92	0.50	114	94	1.2	
9:40	349.92	0.75	97	98	1.4	614
9:45	353.45					

Total, V_m	Average	Avg., T_m
[illegible]	[illegible]	[illegible]

EOF
EOF

[illegible] [illegible]

145<

No Punch
PLANT Phelps - Dodge Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) x (IN.)

2.1
DATE 8/26/76
TIME 8:50 am
RUN 5

2.2
OPERATORS Gilchrist

2.3
STATIC PRESSURE (IN. HG.) - 2.4
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.774

STACK GAS MOLECULAR WEIGHT

2.5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
8:50	2.8	1.0	602
		1.1	604
		1.1	611
		1.2	
		1.4	614

EOF

2.6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
3.6	15	0
4.6	13.1	0
4.3	13.8	0
Average	Average	Average
4.167	13.967	

EOF
EOF

* no data for test #5; use data from test #6.

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (27.7)$$

$$= 1.313\ \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (9.9605)\left(\frac{28.19 + \frac{.66}{13.6}}{556}\right)$$

$$= 8.9542\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{1.313}{1.313 + 8.9592}$$

$$= .1278$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (4.69) + 0.32\ (13.967) + 0.28\ (81.[illegible] + 0) + 0.64\ (\quad)$$

$$= 29.2610 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 29.2610\ (1-.1278) + 18\ (.1278)$$

$$= 27.9457 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48 \text{ X } .784 \text{ X } (.8202) \sqrt{\frac{483}{(28.01)(27.9457)}}$$

$$= 61.7635 \text{ ft/sec}$$

$$Q_s = 3600\,(1 - B_{wo})\,V_{s,avg}\,A\left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\,(1 - .1278)\,(61.7628)(28.2743)\left(\frac{530}{983}\right)\left(\frac{28.01}{29.92}\right)$$

$$= 2{,}767{,}696.2 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\,V_{1c}$$

$$= 0.0474$$

$$= \quad \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,(42.821)\left(\frac{28.19 + \frac{1.633}{13.6}}{528.466}\right)$$

$$= 34.8829 \ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$= \frac{1145.86}{[illegible]} (2.205 \times 10^{-6})$ $\frac{[illegible]}{57[illegible]}$ [illegible]

= [illegible] lb/ft³ = 6.844[illegible]

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$

= (2,761,682) (6.335/x10⁻⁶ [illegible]) (2,761,682 (9.6976x10⁻⁶

= [illegible] lb/hr = 195.[illegible]

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6}\right)\right\}}{\theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(983) \left\{0.00267\ (29.7) + \frac{42.821}{538.306} \left(28.14 + \frac{1.633}{13.6}\right)\right\}}{(60)\ (61.9624)(28.\text{[illegible]})(5.4088 \times 10^{-4})}$$

$= 1.0\text{[illegible]} \times 10^{2}$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right)\left(N\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(0 - .05)(.0107)\left(\frac{280}{5}\right)}{39.8829}$$

$= -8.113 \times 10^{-8}\ lb/ft^3 \simeq 0\ lb/ft^3$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$ER = Q_s\ C_{H_2SO_4}$

$= (2,469,682)(0)$

$\cong 0$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(16.80 - .05)(.6497)\left(\frac{390}{10}\right)}{24.4429}$$

$$= 9.9893 \times 10^{-4}\ \mathrm{lb/ft^3}$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (2,969,682)(9.9893 \times 10^{-4})$$

$$= 2.2106 \times 10^{3}\ \mathrm{lb/hr.}$$

No Punch
PLANT Phelps-Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/26/76
TIME 8:50 am
RUN 5

4,02
OPERATORS Knirck

4,03
STATIC PRESSURE (IN.WG.) -2.4
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.784

STACK PRESSURE (IN HG.) 28.01

4,07
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	8:50	136	221	71	212	77	77	0.5 ✓	0.9	705.543	3
A-2		244	228	69	206	77	77	0.7 ✓	1.2	706.465	3
A-3		560	220	68	210	77	77	0.8 ✓	1.4	707.490	4
A-4	8:55	585	226	67	230	77	77	0.9 ✓	1.6	708.595	4
A-5		585	223	67	242	77	77	1.0 ✓	1.8	709.745	5
A-6		590	231	66	247	78	77	1.0 ✓	1.8	711.000	5
A-7	9:00	587	224	66	244	78	78	1.05 ✓	1.9	712.270	5
A-8		586	223	66	237	78	78	1.05 ✓	1.9	713.525	6
A-9		584	222	67	235	78	78	1.0 ✓	1.8	714.800	5
A-10	9:05	570	222	67	234	78	78	0.9 ✓	1.7	716.095	5
A-11		565	220	68	236	78	78	0.9 ✓	1.7	717.265	5
A-12		560	230	69	234	79	78	0.85 ✓	1.6	718.500	5
A-13	9:10	555	222	70	235	79	78	0.8 ✓	1.6	719.665	5
A-14		552	232	69	234	79	78	0.8 ✓	1.6	720.835	5
A-15		550	230	70	242	79	78	0.8 ✓	1.6	722.030	5
A-16	9:15	550	227	70	251	79	78	0.7 ✓	1.8	723.215	5
A-17		550	229	70	252	79	78	0.7 ✓	1.4	724.280	5
A-18		551	226	70	247	79	78	0.7 ✓	1.4	725.325	5
	9:20					Average	Average			726.490	
		Average				—	—		Average	Total	
		—				Average	—		—	20.947	

EOF

No Punch

PLANT Phelps- Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4,01 DATE 7/26/76
TIME 9:25 am
RUN 5

4,02 OPERATORS Kairck

4,03 STATIC PRESSURE (IN.HG.)
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT

STACK PRESSURE (IN.HG.)
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

METER BOX NUMBER
ORIFICE METER COEFFICIENT
4,05 PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4, 08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-18	9:25	538	232	72	244	79	78	0.5	0.9	726.44	1
B-17		543	231	6 70	241	79	78	0.6	0.8	727.42	2
B-16		543	220	70	241	79	78	0.7	1.2	728.39	2
B-15	9:30	544	218	69	240	79	78	0.75	1.2	729.48[illegible]	2
B-14		546	219	69	241	79	78	0.8	1.3	730.500	2
B-13		547	217	69	243	79	78	1.1	2.0	731.560	2
B-12	9:35	550	231	68	244	79	78	1.1	2.0	732.780	3
B-11		552	223	68	244	79	78	1.2	2.0	734.300	3
B-10		561	218	68	240	79	78	1.3	2.3	735.415	3
B-9	9:40	575	220	68	239	79	78	1.3	2.3	736.885	4
B-8		577	222	67	241	80	78	1.2	2.2	738.210	3
B-7		577	228	67	241	80	78	1.1	2.0	739.610	3
B-6	9:45	577	221	68	241	80	78	1.1	2.0	740.975	3
B-5		578	240	68	242	80	78	1.0	1.8	742.278	3
B-4		579	230	68	243	80	78	1.0	1.8	744.600	3
B-3	9:50	566	228	68	241	80	78	0.9	1.6	745.815	3
B-2		245	230	68	240	80	78	0.8	1.4	746.618	3
B-1		170	227	68	240	80	78	0.8	1.5	747.150	3
	9:55									748.450	
		Average				Average	Average		Average	Total	
		523				78.778	77.[illegible]		1.[illegible]	[illegible]	
						Average	78.[illegible]				

+460
= 983

EOF

20.[illegible]

·0

-2

0.0 PLANT Phelps - Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet

0.1 STACK DIAMETER (IN.) 72

0.2 DUCT DIMENSIONS (IN.) x (IN.)

1.0

1.1 DATE 7/26/76
TIME 2:56 pm
RUN 6

1.2 OPERATORS Gilchrist

1.3 STATIC PRESSURE (IN. WG.) - 2.4
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.774

1OF

1.4 WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1.5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	385	340	405.7
Initial	350	350	379.6
Liquid Collected	35	-10	26.1
			Total, ml
			51.1

EOF

1.6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
2:56	353.62	1.96	104	105	1.2	570
	357.02	1.36	99	103	1.2	610
	360.35	1.60	99	100	1.4	609
	362.186	1.60	101	102	1.4	610
3:46	362.186	1.48	106	107	1.3	597
	365.71	1.37	107	106	1.2	608
	368.86	1.48	107	106	1.3	607
	371.00	1.48	107	105	1.3	605
	375.61	1.48	106	105	1.3	607
	378.213	1.48	107	106	1.3	624
			104.3	104.4		

Total, V_m	Average	Avg., T_m
24.593	1.334	104.4

EOF
EOF

PLANT *Phelps-Dodge, Ajo Arizona*
LOCATION *Rever & ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) x (IN.)

2,1 DATE *7/26/76*
TIME *2:56 pm*
RUN *6*

2,2 OPERATORS *Gilchrist*

2,3 STATIC PRESSURE (IN. HG.) *-2.4*
AMBIENT PRESSURE (IN. HG.) *28.19*
TYPE S PITOT COEFFICIENT *0.774*

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
2:56	3.0	1.2	570
	3.0	1.2	610
	3.3	1.4	609
	3.2	1.3	597
3:46	3.1	1.2	608
	3.2	1.3	607
	3.2	1.3	605
	3.2	1.3	607
	3.2	1.3	624

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
3.8	15.0	0
4.6	13.1	0
4.3	13.8	0
Average	Average	Average
4.17	13.97	0

EOF
EOF

PLANT *Phelps-Dodge, Ajo Arizona*
LOCATION *Reverb ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE *7/26/76*
TIME *2:56 pm*
RUN *6*

4,02 OPERATORS *Knirck*

4,03
STATIC PRESSURE (IN.WG.) *- 2.4*
AMBIENT PRESSURE (IN.HG.) *28.19*
TYPE S PITOT COEFFICIENT *0.784*

STACK PRESSURE (IN.HG.) *28.01*
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER *0015*
ORIFICE METER COEFFICIENT *0.681*
PROBE LENGTH (FT.) *10*
NOZZLE DIAMETER (IN.) *0.25*

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	ΔP Velocity Head (in. wg.)	ΔH Orifice Meter (in. wg.)	Vm Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	2:56	170	250	73	245	85	85	0.8	1.4	754.605	5
A-2		320	250	71	243	85	85	1.0	1.8	756.130	5
A-3		540	250	69	244	85	85	1.1	2.0	757.385	6
A-4	3:01	578	250	67	249	84	85	1.2	2.1	758.680	6
A-5		580	250	67	245	84	85	1.3	2.3	760.970	6
A-6		578	250	66	247	84	85	1.3	2.4	761.90	7
A-7	3:06	580	250	68	248	84	85	1.3	2.4	762.810	8
A-8		580	250	66	248	84	85	1.3	2.4	764.[illegible]	8
A-9		575	249	66	248	84	86	1.3	2.4	765.72[illegible]	8
A-10	3:11	561	246	67	252	85	87	1.3	2.3	767.4[illegible]	8
A-11		555	252	67	252	85	88	1.2	2.1	768.6[illegible]	7
A-12		550	253	68	253	85	89	1.1	2.0	769.90	7
A-13	3:16	547	250	66	250	85	88	1.1	2.0	771.290	7
A-14		544	248	67	249	85	88	1.1	1.9	772.635	7
A-15		550	254	67	250	86	88	1.1	1.9	773.90	7
A-16	3:21	551	251	67	248	86	88	1.1	2.0	775.23	7
A-17		550	245	66	249	85	87	1.1	2.0	776.60	7
A-18		548	244	67	250	86	87	1.0	1.9	777.8[illegible]	7
	3:26									778.[illegible]	
		Average [illegible]				Average [illegible]	Average [illegible]	[illegible]	Average 2.0[illegible]	Total	

EOF

A1B = 521.5
+ 460
981.5

MB = 69.5
+ 460
529.5

$\overline{MB}$=1.93

$\overline{MB}$=1.031

Vm 24.6 + 24.29 = 48.89

$\frac{V}{1.002}$ = 48.792

PLANT Phelps- Dodge Ajo, Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) x (IN.)

4.01 DATE 7/26/76
TIME 3:27 pm
RUN 6

4.02 OPERATORS Kairck
STATIC PRESSURE (IN.WG.) − 2.4
4.03 AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT 0.784

STACK PRESSURE (IN.HG.)
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

METER BOX NUMBER
ORIFICE METER COEFFICIENT
4.05 PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-18	3:27	583	250	70	247	86	88	0.7	1.2	779.20	5
B-17		536	250	69	247	86	88	0.9	1.6	781.362	5
B-16		536	250	67	247	86	88	1.0	1.8	782.625	6
B-15	3:32	538	243	67	247	86	88	1.0	1.8	783.865	6
B-14		538	253	66	245	86	88	1.0	1.9	785.260	6
B-13		538	247	65	244	88	92	1.1	2.0	786.690	6
B-12	3:37	541	247	65	245	88	92	1.1	2.0	788.04	7
B-11		540	245	64	243	87	92	1.2	2.2	789.445	7
B-10		546	248	64	244	87	92	1.2	2.1	790.790	7
B-9	3:42	570	242	63	243	87	92	1.2	2.2	792.175	8
B-8		568	240	64	244	87	93	1.1	2.1	793.635	8
B-7		568	239	64	243	87	93	1.1	1.9	795.020	7
B-6	3:47	570	240	64	244	87	94	1.0	1.9	796.330	6
B-5		570	238	64	244	87	95	1.0	1.8	797.610	6
B-4		572	246	65	246	86	96	0.9	1.7	798.895	6
B-3	3:52	572	246	65	247	86	96	0.8	1.5	800.190	5
B-2		552	250	65	249	86	96	0.8	1.4	801.300	5
B-1		145	245	67	248	86	95	0.7	1.2	802.435	4
	[illegible]									803.990	
		Average				Average	Average		Average	Total	
		[illegible]				[illegible]	92.1		[illegible]		
						Average [illegible]		.991			

EOF

3:57

Phelps Dodge, AJO Reverb
Run 6 - Gilchrist
7/26/76

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (51.1)$$

$$= 2.422\ \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ \left(\underset{1.012}{24\underline{.593}}\right)\left(\frac{28.19 + \frac{1.334}{13.6}}{564.4}\right)$$

$$= 21.5908\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{2.422}{2.422 + 21.5908}$$

$$= .1009$$

$N_2 = 100 - (4.17 + 13.97 + 0)$

2. Stack Gas Composition

M_d = 0.44 (%CO_2) + 0.32 (%O_2) + 0.28 (%N_2 + %CO)

~~+0.64 (%SO_2)~~

= 0.44 (4.17) + 0.32 (13.97) + 0.28 (81.86 + 0) + 0.64 (0)

= 29.23 lb/lb-mole

M_s = M_d (1-B_{wo}) + 18 B_{wo}

= 29.23 (1-.1009) + 18 (.1009)

= 28.097 lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48 \times .784 \times 1.031 \sqrt{\frac{987.5}{28.01 \times 28.097}}$$

= 77.396 ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .1009)\ (99.396)(28.2743)\left(\frac{530}{987.5}\right)\left(\frac{28.01}{29.92}\right)$$

$$= 3{,}558{,}862 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{lc}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474$$

$$= \qquad \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ \underset{1.002}{(98.89)}\left(\frac{28.19 + \frac{1.93}{13.6}}{547.5}\right)$$

$$= 19.916 \quad \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$=$

$=$

5. Concentration of Particulate Matter

at 0 [illegible] 1st [illegible] [illegible]

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$= \frac{[illegible]}{44.916} (2.205 \times 10^{-6})$ $\frac{18[illegible].86}{44.916}$ (2.205×10^{-6}) $\frac{[illegible]}{44.916}$ (2.205×10^{-6})

$= 9.2149 \times 10^{-5}$ lb/ft³ $= 9.3043 \times 10^{-5}$ $= 1.21[illegible] \times 10^{-4}$

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

$= (3,558,862)(9.2149 \times 10^{-5})$ $(3,558,862)(9.3043 \times 10^{-5})$ $(3,558,862)(1.2[illegible])$

$= 330.[illegible]$ lb/hr $= 331.1284$ lb/hr $= 4[illegible]$ lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\overset{941.5}{\quad}) \left\{ 0.00267\ (51.1) + \frac{48.7424}{541.5} \left(28.19 + \frac{1.93}{13.6} \right) \right\}}{(60)\ (71.396)(28.01)(3.4082 \times 10^{-4})}$$

$= 98.6071$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(N\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(18.45 - .05)(.0109)\left(\frac{355}{25}\right)}{44.716}$$

$= 6.9523 \times 10^{-6}$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$= (3,542,862)(6.9523 \times 10^{-6})$

$= 24.631$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(\text{[illegible]} - \text{[illegible]})(\text{[illegible]})\left(\frac{\text{[illegible]}}{\text{[illegible]}}\right)}{\text{[illegible]}}$$

$$= 2.6789 \times 10^{-5} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (\text{[illegible]})(2.6789 \times 10^{-5})$$

$$= \text{[illegible]} \times 10^{2} \text{ lb/hr.}$$

0,0 [PLANT Phelps - Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet

0,1 [STACK DIAMETER (IN.) 72

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/27/76
TIME 8:36 am
RUN 7

1,2 [OPERATORS Gilchrist

1,3 [STATIC PRESSURE (IN. WG.) - 2.4
AMBIENT PRESSURE (IN. HG.) 28.20
TYPE S PITOT COEFFICIENT 0.774

EOF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final			
Initial			
Liquid Collected			
			Total, $V_{\ell c}$

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
8:36	378.385	1.4	98	97	1.3	602
	381.421	1.5	99	98	1.4	606
	384.57	1.4	102	101	1.3	606
9:24	384.57	1.4	108	107	1.3	583
	387.52	1.5	108	107	1.4	609
9:43	390.91	1.3	109	107	1.2	607
	394.08	1.4	108	107	1.3	612
	397.49	1.4	107	106	1.3	612
	400.51	1.4	106	106	1.3	617
10:02	403.663	1.3	105	106	1.2	619

Total, V_m	Average	Avg., T_m
25.278	1.40	104.6

EOF
EOF

+460

$\frac{V_m}{1.02}$ [illegible] = 564.6

No Punch
PLANT Phelps - Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) x (IN.)

2,1
DATE 7/27/76
TIME 8:36 am
RUN 7

2,2 OPERATORS Gilchrist

2,3
STATIC PRESSURE (IN. WG.) -2.4
AMBIENT PRESSURE (IN. HG.) 26.20
TYPE S PITOT COEFFICIENT 0.774

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
8:36	3.1	1.3	655
	3.3	1.4	606
	3.1	1.3	606
9:24	3.1	1.3	593
	3.3	1.4	609

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
3.6	15.0	0
4.6	13.1	0
4.3	13.8	0
Average	Average	Average
4.167	13.967	

EOF
EOF

B Punch

PLANT Phelps Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/27/76
TIME 8:35
RUN 7

4.02 OPERATORS Knirck

4.03
STATIC PRESSURE (IN.HG.) -2.4
AMBIENT PRESSURE (IN.HG.) 28.30
TYPE S PITOT COEFFICIENT 0.784

4.07
STACK PRESSURE (IN.HG.) 28.02
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER CC15
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	8:35	168	257	62	248	75	75	2.1	3.7	811.850	10
A-2		250	250	59	272	75	75	2.0	3.6	813.475	10
A-3		550	248	58	274	75	75	2.0	3.6	815.20	11
A-4	8:40	574	250	59	269	75	75	2.2	3.8	816.945	12
A-5		578	250	60	264	75	75	2.1	3.6	818.660	12
A-6		578	248	61	256	76	75	2.1	3.7	820.440	12
A-7	8:45	580	247	62	244	76	75	2.2	3.8	822.215	13
A-8		588	252	63	242	76	75	2.1	3.8	824.000	13
A-9		574	256	63	248	77	75	2.1	3.8	825.775	13
A-10	8:50	567	247	64	251	76	74	2.0	3.6	827.555	15
A-11		564	255	66	252	78	75	2.1	3.7	829.225	16
A-12		558	248	65	250	78	75	2.1	3.7	831.960	15
A-13	8:55	556	246	64	247	78	75	2.1	3.7	832.75	14
A-14		553	261	64	248	78	75	2.1	3.7	834.515	13
A-15		552	247	63	249	78	75	2.1	3.7	836.285	12
A-16	9:00	551	256	63	250	78	75	2.1	3.7	838.042	12
A-17		551	247	62	250	79	75	2.1	3.7	839.785	12
A-18		549	248	61	249	79	75	2.1	3.7	841.560	12
	9:05					Average	Average			843.840	
		Average				—	—		Average	Total	
						Average	—		—	31.990	

EIR

* test invalid

No Punch

PLANT Phelps - Dodge , Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/27/76
TIME 9:08
RUN 7

4,02 OPERATORS Knirck

4,03
STATIC PRESSURE (IN.WG.) -2.4
AMBIENT PRESSURE (IN.HG.) 28.20
TYPE S PITOT COEFFICIENT 0.784

STACK PRESSURE (IN.HG.) 28.02
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-18	9:08	542	258	64	250	78	77	0.7	1.2	843.62	
B-17		542	256	65	250	78	77	0.8	1.4	844.58[illegible]	
B-16		543	258	65	251	78	77	0.9	1.7	845.69	
B-15	9:13	543	252	65	252	78	77	1.0	1.8	846.[illegible]	
B-14		543	248	64	253	78	78	1.0	1.9	848.0[illegible]	
B-13		544	250	64	252	78	78	1.1	2.0	849.[illegible]25	
B-12	9:18	546	255	64	253	79	78	1.1	2.1	850.665	
B-11		549	258	65	253	79	78	1.2	2.2	852.020	
B-10		550	259	65	251	80	79	1.2	2.2	853.44[illegible]	
B-9	9:23	573	254	65	251	80	78	1.2	2.2	854.8[illegible]	
B-8		573	248	65	252	80	78	1.1	2.0	856.20	
B-7		574	253	66	254	80	79	1.0	1.8	857.[illegible]	
B-6	9:28	577	256	66	253	80	79	1.0	1.8	858.8[illegible]	
B-5		576	256	66	251	80	79	1.0	1.8	860.[illegible]30	
B-4		577	243	66	251	80	79	1.0	1.7	861.40	
B-3	9:33	571	251	66	251	80	79	0.9	1.6	862.60	
B-2											
B-1											
	9:38	Average 5[illegible]0.8				Average [illegible].882	Average 7[illegible].441		Average [illegible]	Total [illegible]	
						Average [illegible]					

EOF

ASO, REVERB ESP
RUN 7
7/29/96

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

Vlc 65.7

$$= 0.0474$$

all moisture calculations based on Bwo test 2

$$= 3.113\ ft^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (24.498)\left(\frac{28.20 + \frac{1.40}{13.6}}{564.6}\right)$$

$$= 22.195\ ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{3.113}{3.113 + 22.195}$$

= [illegible]

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (4.169) + 0.32\ (13.469) + 0.28\ (81.466 + 0) + 0.64\ (\quad)$$

= 29.2254 lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$= 29.225\ (1- .123) + 18\ ($ [illegible] $)$ 2214

= [illegible] lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_pC_p\left(\sqrt{\Delta P}\right)_{avg}\sqrt{\frac{T_{s,avg}}{P_sM_s}}$$

/

= 85.48 X .984 X [illegible] $\sqrt{\frac{[illegible]}{[illegible]}}$

= [illegible] ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .123\ )\ ([illegible])([illegible]) \left(\frac{530}{1000.1}\right)\left(\frac{28.02}{29.92}\right)$$

$$= [illegible]\ \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{lc} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474$$

$$= \quad \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ ([illegible]) \left(\frac{26.20 + \frac{2.8235}{13.6}}{539.162}\right)$$

$$= 41.1941\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at O [illegible]

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$$= \frac{\qquad}{} (2.205 \times 10^{-6})$$

= lb/ft³

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

=

= lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\overset{[illegible]}{\quad}) \left\{ 0.00267\ (\overset{.1754}{65.7}) + \frac{50.864}{537.162} \left(28.20 + \frac{2.8235}{13.6} \right) \right\}}{(60)\ ([illegible])(28.02)(3.4088 \times 10^{-4})}$$

$= $ [illegible]

2.664

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right)\left(N\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(\qquad\qquad)(\qquad)\left(\frac{\quad}{\quad}\right)}{\qquad}$$

$=$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$=$

$=$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \underline{(\qquad\qquad)(\qquad)\left(\underline{\qquad}\right)}$$

$= \qquad$ lb/ft^3

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$=$

$= \qquad$ lb/hr.

0,0 PLANT Phelps-Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet

0,1 STACK DIAMETER (IN.) 72

0,2 DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 DATE 7/28/76
TIME 11:13 am
RUN 8

1,2 OPERATORS Gilchrist

1,3 STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.774

10F

1,4 WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	418	342	313.0
Initial	350	350	300.3
Liquid Collected	68	−8	12.7
			Total, V_{lc}
			72.7

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
11:13	404.129	2.0	99	100	1.8	612
	408.071	2.0	100	99	1.8	619
	411.95	2.0	100	99	1.8	615
12:00	411.95	2.1	100	101	1.9	583
	416.01	2.1	100	100	1.9	612
	419.961	2.1	101	100	1.9	611
	423.910	2.0	100	100	1.8	609
	427.672	2.1	102	101	1.9	613
	431.665	2.1	103	101	1.9	620
	435.645	2.0	104	102	1.8	616
	439.60	2.1	104	102	1.9	613
	443.539	2.0	104	102	1.8	611

Total, V_m	Average	Avg., T_m
[illegible]	2.05	[illegible]

EOF
EOF

PLANT *Phelps - Dodge, Ajo Arizona*
LOCATION *Reverb ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) x (IN.)

2.1 DATE *7/28/76*
TIME *11:13 am*
RUN *8*
2.2 OPERATORS *Gilchrist*
2.3 STATIC PRESSURE (IN. HG.)
AMBIENT PRESSURE (IN. HG.) *28.19*
TYPE S PITOT COEFFICIENT *0.734*

STACK GAS MOLECULAR WEIGHT

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
11:13	3.7	1.8	612
	3.7	1.8	619
	3.7	1.8	616
12:00	3.8	1.9	585
	3.8	1.9	612
	3.8	1.9	611
	3.7	1.8	609
	3.8	1.9	613
	3.8	1.9	620
	3.7	1.8	616
	3.8	1.9	613
	3.7	1.8	611

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
5.9	11.3	0
5.8	11.3	0
5.9	11.2	0
Average	Average	Average
5.867	11.267	0

PLANT *Phelps Dodge, Ajo Arizona*
LOCATION *Reverb ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE *7/26/76*
TIME *11:13 am*
RUN *8*

4.02 OPERATORS *Kouk*

4.03
STATIC PRESSURE (IN.WG.) *-3.0*
AMBIENT PRESSURE (IN.HG.) *28.19*
TYPE S PITOT COEFFICIENT *0.784*

STACK PRESSURE (IN.HG.) *27.97*
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER *0015*
ORIFICE METER COEFFICIENT *0.681*
PROBE LENGTH (FT.) *10*
NOZZLE DIAMETER (IN.) *0.25*

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A 1	11:13	165	252	68	242	80	81	1.1 ✓	2.0	71.162	8
A 2		273	243	64	245	81	81	1.3 ✓	2.3	72.445	10
A 3		535	246	62	249	81	81	1.4 ✓	2.5	73.790	10
A 4	11:18	586	259	61	247	81	81	1.6 ✓	2.9	75.250	11
A 5		572	253	60	246	81	81	1.7 ✓	3.1	77.70	15
A 6		542	258	60	248	80	81	1.7 ✓	3.1	78.332	16
A 7	11:23	543	258	63	250	81	81	1.7 ✓	3.1	79.95	16
A 8		593	260	63	253	81	81	1.6 ✓	3.0	81.555	15
A 9		589	246	63	250	81	81	1.6 ✓	3.0	83.182	15
A 10	11:28	572	256	63	251	82	82	1.7 ✓	3.0	84.785	14
A 11		567	254	63	[illegible]	82	82	1.6 ✓	3.0	86.352	15
A 12		564	247	63	251	82	82	1.6 ✓	3.0	87.90	15
A 13	11:33	561	256	63	252	82	82	1.6 ✓	2.9	89.570	15
A 14		553	258	63	254	82	82	1.5 ✓	2.8	91.135	14
A 15		558	263	63	251	82	82	1.5 ✓	2.7	92.705	13
A 16	11:38	561	252	63	251	82	82	1.5 ✓	2.7	94.228	14
A 17		562	250	63	253	82	82	1.5 ✓	2.7	95.730	14
A 18		562	258	64	251	82	82	1.3 ✓	2.3	97.270	13
	11:43									98.718	
		Average				Average	Average		Average	Total	
		—				—	—		—	27.55	
						Average —					

NO PUNCH

PLANT Phelps-Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/28/76
TIME 11:44 am
RUN 8

4.02 OPERATORS Knirk

4.03
STATIC PRESSURE (IN.WG.) − 3.0
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.784

4.07
STACK PRESSURE (IN.HG.) 27.97
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-18	11:44	553	251	68	217	82	82	1.0	1.8	98.712	8
B-17		553	253	67	253	82	82	1.2	1.8	99.745	10
B-16		552	252	67	254	82	82	1.3	2.3	101.300	11
B-15	11:49	552	256	67	252	82	82	1.3	2.3	102.824	11
B-14		552	258	66	251	81	82	1.5	2.6	104.135	12
B-13		553	258	64	252	81	81	1.5	2.5	105.600	13
B-12	11:54	555	253	63	250	81	81	1.6	2.9	107.140	13
B-11		557	257	65	251	82	82	1.7	3.1	108.682	14
B-10		567	250	62	250	82	82	1.8	3.2	110.360	15
B-9	11:59	580	254	61	251	82	82	1.7	3.1	111.934	16
B-8		583	255	61	253	82	82	1.6	2.9	113.565	15
B-7		583	255	61	253	82	82	1.5	2.7	115.165	13
B-6	12:04	584	256	62	252	82	82	1.4	2.5	116.715	13
B-5		584	250	62	257	82	82	1.3	2.3	118.190	[illegible]
B-4		584	251	62	252	82	82	1.3	2.3	119.600	10
B-3	12:09	579	251	62	251	82	82	1.2	2.2	121.001	10
B-2		240	255	62	251	81	82	1.1	2.0	122.310	9
B-1		160	258	62	254	82	83	1.0	1.8	123.720	9
	12:14									125.[illegible]	
		Average 573.028				Average 81.522	Average 81.636		Average [illegible]	Total [illegible]	
						Average 81.629					

+460
= 1033.028

+460
541.629

2785.26

ASO . REVERB ESP
RUN 8
9/28/96

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{lc}\left(\frac{\rho H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474\ (72.7)$$

$$= 3.446\ \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (38.942)\left(\frac{28.19 + \frac{2.05}{13.6}}{561}\right)$$

$$= 34.84145\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{3.446}{3.446 + 34.84145}$$

= .09[illegible]

2. Stack Gas Composition

$$M_d = 0.44\,(\%CO_2) + 0.32\,(\%O_2) + 0.28\,(\%N_2 + \%CO)$$

$$+0.64\,(\%SO_2)$$

$$= 0.44\,(\text{[illegible]}) + 0.32\,(\text{[illegible]}) + 0.28\,(\text{[illegible]} + 0) + 0.64\,(\quad)$$

= [illegible] lb/lb-mole

$$M_s = M_d\,(1-B_{wo}) + 18\,B_{wo}$$

$$= \text{[illegible]}\,(1-\text{[illegible]}) + 18\,(\text{[illegible]})$$

= [illegible] lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48 \times .784 \times \text{[illegible]}\sqrt{\frac{\text{[illegible]}}{(\text{[illegible]})(\text{[illegible]})}}$$

= [illegible] ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .0900)\ (40.112)(28.2743) \left(\frac{530}{989.083}\right)\left(\frac{29.97}{29.92}\right)$$

$$= 4\ 18{,}118 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= \quad ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (53.136) \left(\frac{28.19 + \frac{2.631}{13.6}}{541.634}\right)$$

$$= 49.87 \quad ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$=$$

5. Concentration of Particulate Matter

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$$= \frac{[illegible]}{[illegible]} (2.205 \times 10^{-6})$$ [illegible]

$= [illegible]$ lb/ft³ [illegible]

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

$= [illegible]$ [illegible]

$= [illegible]$ lb/hr [illegible] lb/hr. [illegible] lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{lc} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(464.083) \left\{ 0.00267\ (92.9) + \frac{53.736}{541.639} \left(28.19 + \frac{2.631}{13.6} \right) \right\}}{(60)\ (40.112)(29.97)(3.4088 \times 10^{-4})}$$

$= 96.2145$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(0 - .05)(.01331)\left(\frac{315}{5}\right)}{49.87}$$

$= \sim 0$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$ER = Q_s\ C_{H_2SO_4}$

$= (4,181,118)(0)$

$= \sim 0$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(18.10 - .05)(.6119)\left(\frac{500}{50}\right)}{88.81}$$

$= 8.0041 \times 10^{-4}$ lb/ft^3

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (4,181,118)(8.0041 \times 10^{-4})$$

$= 3.3067 \times 10^{3}$ lb/hr.

0,0 [PLANT Phelps Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet

0,1 [STACK DIAMETER (IN.) 72

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/28/76
TIME 7:16 pm
RUN 9

1,2 [OPERATORS C. Achrist

1,3 [STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.774

EOF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
T_{wm}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	430	340	305.2
Initial	350	350	290.3
Liquid Collected	80	-10	14.9
			Total, V_{lc}
			84.9

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
7:16	443.81	1.9	96	97	1.7	592
	447.495	2.1	95	96	1.9	597
	451.51	1.9	94	92	1.7	594
	453.03	1.9	95	94	1.7	596
8:05	453.03	1.9	94	95	1.7	600
	456.86	2.0	93	94	1.8	599
	460.76	1.9	93	94	1.7	599
	464.52	1.9	93	93	1.7	608
	468.292	1.9	93	93	1.7	598
	472.075	1.9	92	92	1.7	598
	475.840	2.0	92	92	1.8	599
	479.730	2.0	88	90	1.8	599
						601

Total, V_m	Average	Avg., T_m
35.42	1.942	93.333

EOF

V_m +460

1.012 = 35.494 = 553.333

185<

PLANT *Phelps Dodge Ajo Arizona*
LOCATION *Reverb ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) x (IN.)

2.1 DATE *7/28/76*
TIME *2:10 pm*
RUN *4*

2.2 OPERATORS *G. Gilbert*

2.3 STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) *28.19*
TYPE S PITOT COEFFICIENT *0.774*

STACK GAS MOLECULAR WEIGHT

2.1

Clock Time	Rotameter Reading (CFH)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
2:10	3.6	1.7	582
	3.8	1.9	597
	3.6	1.7	594
	3.6	1.7	[illegible]
	3.7	1.8	599
	3.6	1.7	599
	3.6	1.7	600
	3.6	1.7	597
	3.6 3.7	1.7 1.8	576
	3.7	1.8	[illegible]
			[illegible]

EOF

2.6

CO$_2$ (% by Vol.)	O$_2$ (% by Vol.)	CO (% by Vol.)
6.2	10.9	0.1
6.2	10.8	0.0
6.2	10.9	0.0
Average	Average	Average
6.2	10.867	

EOF
EOF

PLANT Phelps Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/28/76
TIME 7:16 pm
RUN 9

4.02 OPERATORS Knick

4.03
STATIC PRESSURE (IN.HG.) -3.2
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.784

4.07
STACK PRESSURE (IN.HG.) 27.95
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	7:16	545	242	64	246	80	82	1.1	2.0	33.317	6
A-2		570	240	60	248	80	82	1.2	2.2	34.697	7
A-3		530	245	59	248	80	82	1.4	2.5	36.060	8
A-4	7:21	570	249	57	246	78	82	1.6	2.9	37.532	9
A-5		570	245	57	245	78	81	1.6	3.0	39.080	9
A-6		572	248	57	246	78	81	1.6	3.0	40.675	9
A-7	7:26	574	257	58	246	78	81	1.7	3.1	42.302	9
A-8		574	258	58	246	77	80	1.7	3.1	43.905	10
A-9		572	255	59	249	78	80	1.6	3.0	45.560	9
A-10	7:31	560	258	60	250	78	80	1.6	3.0	47.185	9
A-11		553	245	60	248	78	80	1.6	3.0	48.785	9
A-12		548	249	60	248	78	80	1.61	3.0	50.390	9
A-13	7:36	544	245	61	249	78	80	1.5	2.9	52.082	8
A-14		542	245	61	250	78	80	1.5	2.7	53.560	8
A-15		541	255	62	249	78	80	1.5	2.6	55.095	8
A-16	7:41	540	247	62	249	78	80	1.5	2.6	56.623	8
A-17		540	259	62	249	78	80	1.5	2.6	58.096	8
A-18		540	250	63	249	78	79	1.3	2.3	59.610	7
	7:46	Average —				Average — Average —	Average —		Average —	61.032 Total 27.715	

EOF

PLANT Phelps Dodge - Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/28/76
TIME 7:46 pm
RUN 9

4.02 OPERATORS Frick

4.03
STATIC PRESSURE (IN.WG.) -3.2
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.784

STACK PRESSURE (IN.HG.) 27.95
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.08
METER BOX NUMBER 10015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. Hg.)
B-18	7:49	536	250	64	249	78	79	0.8	[illegible]	61.0[illegible]	[illegible]
B-17		541	[illegible]	62	248	77	79	1.1	2.0	62.[illegible]	[illegible]
B-16		541	250	61	250	77	79	1.2	2.2	63.5[illegible]	8
B-15	7:54	541	246	61	251	77	79	1.3	2.3	64.8[illegible]	8
B-14		542	255	62	240	77	78	1.4	2.5	66.283	8
B-13		543	260	62	249	76	79	1.5	2.7	67.753	9
B-12	7:59	544	261	63	250	77	79	1.5	2.7	69.260	9
B-11		548	256	63	249	77	78	1.6	2.9	70.782	9
B-10		556	258	64	250	77	78	1.6	3.0	72.3[illegible]	10
B-9	8:04	570	260	64	249	77	78	1.6	3.0	74.900	10
B-8		570	255	64	250	77	78	1.5	2.8	75.5[illegible]	10
B-7		570	249	64	250	77	78	1.4	2.5	77.[illegible]	9
B-6	8:09	571	250	64	251	78	78	1.3	2.3	78.056	8
B-5		571	246	64	251	77	78	1.3	2.3	80.750	8
B-4		572	253	64	249	78	78	1.2	2.2	81.6[illegible]	7
B-3	8:14	570	255	64	250	78	78	1.1	2.0	82.90[illegible]	7
B-2		290	253	64	251	77	78	1.0	1.8	84.222	7
B-1		135	245	64	251	77	78	0.9	1.7	85.522	6
	8:19	Average 516.58[illegible]				Average 76.583	Average 78.444		Average 2.54[illegible]	86.746 Total [illegible]	
		+460				Average 77.514					
		= 976.58[illegible]				+460					
						= 537.514					

EDF

H3O, KEVERS ESP
RUN 9
7/28/76

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho_{H_2O}}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\,V_{1c}$$

$$= 0.0474\ (84.9)$$

$$= 4.0243\ \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (35.444)\left(\frac{28.19 + \frac{1.942}{13.6}}{553.333}\right)$$

$$= 32.1869\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{4.0243}{4.0243 + 32.1869}$$

$$= .1111$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (6.2) + 0.32\ (10.469) + 0.28\ ([illegible] + 0) + 0.64\ (\quad)$$

= [illegible] lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 29.4[illegible]\ (1-.1111) + 18\ (.1111)$$

= 28.1572 lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \text{ X } .784 \text{ X } 1.1154 \sqrt{\frac{976.556}{(27.95)(28.1572)}}$$

= 83.267 ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .1111\ )\ (83.267)(28.2943) \left(\frac{530}{976.556}\right)\left(\frac{27.95}{29.92}\right)$$

$$= 3{,}811{,}611 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= \quad ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (53.322) \left(\frac{28.19 + \frac{2.547}{13.6}}{537.514}\right)$$

$$= 49.855 \quad ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 0 [illegible] | 1st reading | [illegible]

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$$= \frac{1619.46}{44.215} (2.205 \times 10^{-6}) \quad \frac{1739.46}{44.215} (2.205 \times 10^{-6}) \quad \frac{2315.4}{[illegible]} \quad 10^{-6}$$

$= 7.1537 \times 10^{5}$ lb/ft³ $\quad = 7.693 \times 10^{-5}$ $\quad$ = [illegible]

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

= (3819611) $\quad$ (3819611)(7.693 × 10^-5) $\quad$ 3819611 [illegible]

= 273.24 lb/hr $\quad$ = 293.8553 lb/hr $\quad$ = [illegible] lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(476.556) \left\{ 0.00267\ (84.9) + \frac{53.322}{537.514} \left(28.19 + \frac{2.547}{13.6} \right) \right\}}{(60)\ (83.267)(29.95)(3.4088 \times 10^{-4})}$$

$$= 1.0403 \times 10^{2}$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right)\left(N\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(10.80 - .05)(.01331)\left(\frac{28.5}{10}\right)}{49.855}$$

$$= 8.8338 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (3,814,611)(8.8336 \times 10^{-6})$$

$$= 33.6976\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(8.50 - .05)(.6819)\left(\frac{365}{10}\right)}{49.485}$$

$$= 2.9963 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (3,794,611)(2.9963 \times 10^{-4})$$

$$= 1.1368 \times 10^3 \text{ lb/hr.}$$

0,0 [PLANT Phelps-Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet

0,1 [STACK DIAMETER (IN.) 72

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/29/76
TIME 10:12 am
RUN 10

1,2 [OPERATORS Gilchrist

1,3 [STATIC PRESSURE (IN. WG.) — 3.0
AMBIENT PRESSURE (IN. HG.) 28.15
TYPE S PITOT COEFFICIENT 0.774

10F

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	437	344	301.6
Initial	350	350	286.2
Liquid Collected	87	−6	15.4
			Total, V_{lc}
			96.4

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
10:12	480.422	1.71	97	97	1.5	609
	484.05	1.71	96	95	1.5	603
	487.44	1.71	96	97	1.5	606
11:06	488.77	1.71	95	97	1.5	607
	492.37	1.71	95	95	1.5	611
	495.845	1.71	95	95	1.5	607
	499.38	1.71	94	95	1.5	606
	502.87	1.59	93	94	1.4	603
	506.87	1.71	92	93	1.5	604
	507.85	1.71	91	93	1.5	604
	513.32	1.71	91	92	1.5	605
	516.886	1.82	90	92	1.6	607
	Total, V_m	Average	Avg., T_m			
	36.464	1.709	94.167			

EOF
EOF

$\frac{V_m}{1.012} = 36.0316$

+460
= 544.167

No Punch
PLANT Phelps-Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) x (IN.)

2.1
DATE 7/29/76
TIME 10:12 am
RUN 10

2.2 OPERATORS Gilchrist

2.3
STATIC PRESSURE (IN. WG.) – 3.0
AMBIENT PRESSURE (IN. HG.) 28.15
TYPE S PITOT COEFFICIENT 0.774

STACK GAS MOLECULAR WEIGHT

2.5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
10:12	3.4	1.5	609
	3.4	1.5	603
	3.4	1.5	604
11:06	3.4	1.5	607
	3.4	1.5	611
	3.4	1.5	607
	3.4	1.5	606
	3.3	1.4	603
	3.4	1.5	604
	3.4	1.5	604
	3.4	1.5	605
	3.5	1.6	607

EOF

2.6

CO$_2$ (% by Vol.)	O$_2$ (% by Vol.)	CO (% by Vol.)
6.3	10.5	0
6.3	10.6	0
6.3	10.5	0
Average	Average	Average
6.3	10.533	0

EOF
EOF

8 Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 12
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/29/76
TIME 10:12 am
RUN 10

4,02 OPERATORS Kenck

4,03
STATIC PRESSURE (IN.WG.) -3.0
AMBIENT PRESSURE (IN.HG.) 28.15
TYPE S PITOT COEFFICIENT 0.811

STACK PRESSURE (IN.HG.) 27.93
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER CC15
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A 1	10:12	82	256	75	252	79	80	0.4	0.7	95.283	3
A 2		84	258	72	252	79	80	1.1	2.1	96.100	9
A 3		84	244	69	253	79	80	1.0	2.1	97.337	9
A 4	10:17	84	251	67	252	79	80	1.1	2.1	98.682	9
A 5		111	250	65	252	79	80	1.3	2.5	100.025	12
A 6		360	246	67	250	80	80	1.3	2.5	101.500	12
A 7	10:22	575	250	65	252	80	80	1.3	2.5	102.810	12
A 8		583	251	65	256	80	80	1.3	2.5	104.240	12
A 9		583	259	65	255	80	81	1.3	2.5	105.710	12
A 10	10:27	574	252	65	252	80	81	1.4	2.7	107.180	13
A 11		568	268	66	253	80	80	1.4	2.6	108.672	13
A 12		564	247	65	256	80	80	1.4	2.6	110.187	13
A 13	10:32	561	255	65	257	80	80	1.3	2.5	111.685	13
A 14		558	260	65	253	80	80	1.3	2.5	113.142	13
A 15		556	255	65	251	80	80	1.3	2.4	114.632	12
A 16	10:37	554	247	65	251	80	80	1.2	2.3	116.068	12
A 17		552	255	64	251	80	80	1.2	2.3	117.500	12
A 18		550	254	64	253	81	80	1.1	2.1	118.905 120.273	11
	10:42	Average 411.41				Average 79.777	Average 80.333		Average 2.172	Total 24.990	
						Average	80.056				

EOF

+460
897.41

+460
= 540.056

$(\sqrt{\Delta P})_{avg}$ = 1.0554

24.990 + 23.742
= 48.732

$\frac{V_m}{1.002}$ = 48.635

& Punch

PLANT Phelps-Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/29/76
TIME 10:50 am
RUN 10

4,02 OPERATORS Knirk

4,03
STATIC PRESSURE (IN.WG.) − 3.0
AMBIENT PRESSURE (IN.HG.) 28.15
TYPE S PITOT COEFFICIENT 0.811

4,07
STACK PRESSURE (IN.HG.) 27.93
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-18	10:50	542	251	67	254	79	80	0.8	1.5	20.215	6
B-17		545	251	64	251	79	81	0.9	1.8	21.350	8
B-16		546	254	62	251	79	80	1.0	2.0	22.640	9
B-15	10:55	548	249	62	252	78	80	1.1	2.2	23.951	10
B-14		549	256	63	254	79	80	1.2	2.4	25.300	11
B-13		560	250	64	252	79	81	1.2	2.4	26.760	12
B-12	11:00	560	261	64	251	79	80	1.2	2.4	28.177	12
B-11		565	256	65	253	80	80	1.3	2.5	29.655	12
B-10		573	248	65	251	80	80	1.4	2.7	31.040	14
B-9	11:05	574	257	66	252	80	80	1.3	2.5	32.541	14
B-8		575	251	66	253	81	81	1.2	2.3	34.120	13
B-7		578	250	66	252	81	81	1.1	2.2	35.468	14
B-6	11:10	296	253	67	251	81	81	1.0	2.0	[illegible]	14
B-5		110	248	67	253	80	81	1.0	1.9	[illegible] 180	12
B-4		90	263	64	256	80	81	0.8	1.5	37.466	10
B-3	11:15	83	260	67	256	81	81	0.7	1.3	40.665	7
B-2		85	248	67	256	80	81	0.7	1.3	41.752	7
B-1	11:20	85	248	67	253	80	81	1.0	1.8	42.831 44.612	6
		Average				Average	Average		Average	Total	

EDF

AJO, REVERB ESP
RUN 10
7/24/76

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (96.4)$$

$$= 4.5694\ ft^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (26.0316)\left(\frac{28.15 + \frac{1.709}{13.6}}{544.167}\right)$$

$$= 33.1576\ ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{4.5694}{4.5694 + 33.1576}$$

$$= 12.11$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (6.3) + 0.32\ (10.[illegible]) + 0.28\ (83.1[illegible] + 0) + 0.64\ (0)$$

$$= 29.4243 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 29.4243\ (1- .1211) + 18\ (.1211)$$

$$= 28.04[illegible] \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \text{ X } .811 \text{ X } 1.0564 \sqrt{\frac{899.492}{(29.93)\ (28.04[illegible])}}$$

$$= 99.4601 \text{ ft/sec}$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1- .1211)\ (77.460)(28.2943) \left(\frac{530}{877.992}\right) \left(\frac{27.93}{29.92}\right)$$

$=$ 3,904,449 scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$=$ ft³

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (48.625) \left(\frac{28.15 + \frac{2.192}{13.6}}{540.056}\right)$$

$=$ 16.1509 ft³

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$=$

$=$

5. Concentration of Particulate Matter

[illegible] | [illegible] | [illegible]

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$= \frac{[illegible]}{[illegible]} (2.205 \times 10^{-6})$ [illegible] [illegible]

$= 1.[illegible]833 \times 10^{-4}$ lb/ft³ $= 1.[illegible]53 \times$ [illegible] 1.4003×10^{-4}

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

$= (3,904,[illegible])(1.0833 \times [illegible])$ $(3,904,[illegible])([illegible])$ 3904959 1.4003×10^{-4}

$=$ [illegible].0318 lb/hr 4[illegible].[illegible] lb/hr [illegible]8341 lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\overset{877.472}{\quad}) \left\{ 0.00267\ (96.4) + \frac{48.685}{540.066} \left(28.15 + \frac{2.172}{13.6} \right) \right\}}{(60)\ (77.4601)(27.93)(3.4088 \times 10^{-4})}$$

$= 42.8591$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(8.35 - .05)(.01331)\left(\frac{320}{10}\right)}{45.1507}$$

$= 8.456 \times 10^{-6}$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$= (3,401,494)(8.456 \times 10^{-6})$

$= 38.0204$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(13.40 - .05)(.6914)\left(\frac{425}{5}\right)}{45.1607}$$

$$= 1.2259 \times 10^{-3} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (3,904,959)(1.2259 \times 10^{-3})$$

$$= 4.7872 \times 10^{3} \text{ lb/hr.}$$

0,0 [PLANT Phelps - Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet

0,1 [STACK DIAMETER (IN.) 72

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/29/76
TIME 4:02 pm
RUN 11

1,2 [OPERATORS Gilchrist

1,3 [STATIC PRESSURE (IN. WG.) -2.7
AMBIENT PRESSURE (IN. HG.) 28.15
TYPE S PITOT COEFFICIENT 0.774

1OF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{WO}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	391	346	284.9
Initial	350	350	275.1
Liquid Collected	41	-4	9.8
			Total, V_{lc}
			46.8

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
4:02	517.17	1.71	91	91	1.5	632
	520.731	1.71	90	90	1.5	618
4:50	524.26	1.71	90	90	1.5	614
	527.87	1.71	93	93	1.5	610
	531.40	1.71	93	93	1.5	607
	535.01	1.71	93	92	1.5	604
	536.11					

Total, V_m	Average	Avg., T_m
18.94	1.71	91.583

EOF
EOF

$\frac{V_t}{1.00}$ = 18.9184

460
= 551.583

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) x (IN.)

2.1
DATE 7/29/76
TIME 4:02 pm
RUN 11

2.2 OPERATORS Gilchrist

2.3
STATIC PRESSURE (IN. HG.) -2.7
AMBIENT PRESSURE (IN. HG.) 28.15
TYPE S PITOT COEFFICIENT 0.774

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
4:02	3.4	1.5	622
	3.4	1.5	616
4:50	3.4	1.5	614
	3.4	1.5	610
	3.4	1.5	601
	3.4	1.5	614

EOF

2.6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
5.9	11.4	0
5.8	11.5	0
5.8	11.7	0
Average	Average	Average
5.833	11.533	0

EOF
EOF

No Punch
PLANT *Phelps Dodge, Ajo Arizona*
LOCATION *Reverb ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE *7/29/76*
TIME *4:00 pm*
RUN *11*

4,02
OPERATORS *Knick*

4,03
STATIC PRESSURE (IN.WG.) *-2.7*
AMBIENT PRESSURE (IN.HG.) *28.15*
TYPE S PITOT COEFFICIENT *0.811*

STACK PRESSURE (IN.HG.) *27.95*
4,07
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{WO}

4,05
METER BOX NUMBER *0015*
ORIFICE METER COEFFICIENT *0.681*
PROBE LENGTH (FT.) *10*
NOZZLE DIAMETER (IN.) *0.25*

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	4:00	83	250	67	252	79	80	0.4	0.8	2.950	6
A-2		83	254	63	252	78	80	1.0	2.0	3.880	9
A-3		83	250	60	251	78	80	1.0	2.0	5.205	9
A-4	4:05	82	253	59	252	78	80	1.0	2.0	6.532	9
A-5		115	252	57	251	78	80	1.3	2.5	7.850	11
A-6		335	250	56	251	78	80	1.4	2.6	9.290	12
A-7	4:10	586	246	55	251	78	80	1.3	2.6	10.787	13
A-8		595	256	55	252	78	80	1.3	2.5	12.265	13
A-9		596	251	56	252	78	80	1.3	2.5	13.757	13
A-10	4:15	590	251	56	252	79	80	1.4	2.6	5.242	13
A-11		585	260	57	253	79	80	1.3	2.6	6.725	13
A-12		577	259	57	251	79	80	1.3	2.6	8.220	13
A-13	4:20	577	250	58	249	80	80	1.3	2.5	9.722	13
A-14		588	250	59	253	80	80	1.3	2.5	20.193	13
A-15		563	255	59	251	80	80	1.2	2.4	22.662	12
A-16	4:25	563	257	59	251	80	80	1.2	2.4	24.118	12
A-17		560	254	59	252	80	80	1.2	2.3	25.545	12
A-18		556	248	59	252	80	80	1.1	2.2	26.955	11
	4:30					Average 80.222	Average 80.333			28.332	
		Average 424.22				Average 80.278			Average 2.1654	Total 25.882	

EOF

2=60

460
= 884.2

460
= 540.278

$(\sqrt{\Delta P})_{avg}$
= 1.0482

25.882 + 23.068
= 48.950

$\frac{V_m}{1.002}$ = 48.8523

No Punch

PLANT Phelps Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/29/76
TIME 4:34 pm
RUN 11

4,02 OPERATORS Knirck

4,03
STATIC PRESSURE (IN.WG.) -2.7
AMBIENT PRESSURE (IN.HG.) 28.15
TYPE S PITOT COEFFICIENT 0.811

STACK PRESSURE (IN.HG.) 27.95
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4, 08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-18	4:34	538	246	64	252	80	80	0.8	1.5	28.332	7
B-17		554	249	62	252	80	80	0.9	1.8	29.440	9
B-16		558	246	61	253	80	80	1.0	2.1	30.751	11
B-15	4:39	560	258	61	254	80	80	1.1	2.1	32.190	12
B-14		563	248	63	255	81	81	1.2	2.2	33.415	12
B-13		565	250	64	253	82	81	1.2	2.3	34.815	11
B-12	4:44	568	250	69	252	82	81	1.3	2.4	36.200	12
B-11		578	246	64	253	82	81	1.3	2.5	37.583	13
B-10		583	254	63	254	82	81	1.4	2.7	39.050	14
B-9	4:49	585	249	63	253	82	81	1.4	2.6	40.543	14
B-8		586	256	62	252	83	81	1.2	2.3	42.055	13
B-7		583	249	62	252	83	81	1.1	2.2	43.465	12
B-6	4:54	280	256	62	250	83	81	1.0	2.1	44.824	11
B-5		110	246	61	250	82	81	1.0	1.9	46.150	10
B-4		90	251	61	252	82	80	0.8	1.6	47.428	9
B-3	4:59	83	256	61	253	82	80	0.7	1.4	48.635	8
B-2		86	247	61	252	81	81	0.7	1.3	49.724	7
B-1		85	245	61	250	81	81	0.7	1.3	50.800	6
	5:04					Average —	Average —			51.900	
		Average —				Average	—		Average	Total	

EOF

ASU, REVERB ESP
RUN 11
7/29/76

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{lc} \left(\frac{\rho\, H_2O}{M_{H_2O}}\right)\left(\frac{R\, T_{std}}{P_{std}}\right)$$

$$= 0.0474\, V_{lc}$$

$$= 0.0474\,(46.8)$$

$$= 2.2183 \text{ ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,(18.7154)\left(\frac{28.15 + \frac{1.71}{13.6}}{551.583}\right)$$

$$= 16.9911 \text{ ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{2.2183}{2.2183 + 16.9911}$$

$$= .11548$$

2. Stack Gas Composition

$$M_d = 0.44\,(\%CO_2) + 0.32\,(\%O_2) + 0.28\,(\%N_2 + \%CO)$$

$$+0.64\,(\%SO_2)$$

$$= 0.44\,(5.[illegible]) + 0.32\,(11.[illegible]) + 0.28\,(82.639 + 0) + 0.64\,(0)$$

$$= 29.3946 \text{ lb/lb-mole}$$

$$M_s = M_d\,(1-B_{wo}) + 18\,B_{wo}$$

$$= 29.3946\,(1-.11548) + 18\,(.11548)$$

$$= 28.0988 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48 \text{ X } .811 \text{ X } 1.0482 \sqrt{\frac{884.22}{(29.45)(28.0988)}}$$

$$= 77.1311 \text{ ft/sec}$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .11548)\ (77.131)(28.2743)\left(\frac{530}{884.22}\right)\left(\frac{27.95}{29.92}\right)$$

$= 3,888,$[illegible] scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{lc}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474$$

$= \quad ft^3$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (48.8523)\left(\frac{28.15 + \frac{2.1639}{13.6}}{540.298}\right)$$

$= 45.$[illegible] ft^3

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 0 sec | 1st [illegible] | [illegible]

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

= $\frac{[illegible]}{[illegible]8}$ (2.205 X 10^{-6}) $\frac{[illegible]3.42}{45.332[illegible]}$ ([illegible] 10^{-6}) $\frac{[illegible]}{[illegible]}$ [illegible] 10

= 1.1104 x 10^{-4} lb/ft^3 = 1.1151 x 10^{-4} = 1.35[illegible]

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

= (3,888,367)(1.1104 x 10^{-4}) (3,888,367)(1.1151 x 10^{-4}) (3888 367)(1.3584 x 10^{-4})

= 431.[illegible] lb/hr = 433.[illegible] lb/hr [illegible] lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\overset{884.22}{\quad}) \left\{ 0.00267\ (46.8) + \frac{48.8523}{540.278} \left(28.15 + \frac{2.1634}{13.6} \right) \right\}}{(60)\ (97.1311)(29.45)(3.4088 \times 10^{-4})}$$

$$= 89.9431$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(8.35 - .05\quad)(.01331)\left(\frac{320}{10}\right)}{45.3328}$$

$$= 8.422 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

= (3,8[illegible]69) (8.422×10^{-6})

= 32.148 lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(9.00 - .05)(.6419)\left(\frac{325}{5}\right)}{45.33[illegible]}$$

$$= 6.2549 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (3,888,354)(6.2549 \times 10^{-4})$$

$$= 2.434 \times 10^{3} \text{ lb/hr.}$$

0,0 [PLANT Phelps - Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet

0,1 [STACK DIAMETER (IN.) 72

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/30/76
TIME 11:16 am
RUN 12

1,2 [OPERATORS Gilchrist

1OF

1,3 [STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.774

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	446	340	290.9
Initial	350	350	278.5
Liquid Collected	96	-10	12.4
			Total, V_{lc}
			98.4

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Heading (cfh)	Gas Meter Temp (°F) in	out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
11:16	536.265	1.71	100	100	1.5	585
	539.885	1.59	99	100	1.4	592
	543.46	1.59	99	100	1.4	583
	546.93	1.59	99	99	1.4	588
12:12	547.19	1.71	10	101	1.5	586
	551.35	1.71	10	101	1.5	584
	554.73	1.71	102	102	1.5	583
	558.11	1.71	102	102	1.5	585
	561.71	1.82	102	101	1.6	586
	566.65	1.71	102	102	1.5	585
	569.31	1.82	103	102	1.6	586

	Total, V_m	Average	Avg., T_m
	33.045	[illegible]	[illegible]

EOF
EOF

$\frac{V_m}{1.0U} = 32.653$

No Punch
PLANT Phelps-Dodge Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) x (IN.

2,1 DATE 7/30/76
TIME 11:16 am
RUN 12

2,2 OPERATORS Gilchrist

2,3 STATIC PRESSURE (IN. HG.)
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.774

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh	Velocity Head (in. wg.)	Stack Gas Temp (°F)
11:16	3.4	1.5	585
	3.3	1.4	592
	3.3	1.4	583
	3.3	1.4	589
	3.4	1.5	586
	3.4	1.5	584
	3.4	1.5	583
	3.4	1.5	585
	3.5	1.6	586
	3.4	1.5	585
	3.5	1.6	586
	3.4	1.5	585

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
5.9	11.4	0
5.8	11.5	0
5.8	11.7	0
Average	Average	Average
5.833	11.533	0

EOF
EOF

*-no gas analysis for #12; use data from #1

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Reverb ESP Outlet
STACK DIAMETER (IN.) 72
DUCT DIMENSIONS (IN.) X (IN.)

1,01
DATE 7/30/76
TIME 11:20 am
RUN 12

1,02 OPERATORS Knirck

1,03
STATIC PRESSURE (IN.WG.) -2.7
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.811

STACK PRESSURE (IN.HG.) 27.99
1,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

1,05
METER BOX NUMBER 0015
ORIFICE METER COEFFICIENT 0.681
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.25

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A 1	11:20	87	246	78	250	83	84	0.4 ✓	0.8	0.092	4
A 2		88	246	69	260	82	83	1.1 ✓	2.1	0.942	4
A 3		85	258	64	255	81	83	1.0 ✓	1.9	2.075	9
A 4	11:25	85	254	63	250	81	83	1.0 ✓	1.9	3.410	9
A 5		109	255	62	251	81	83	1.3 ✓	2.4	4.680	13
A 6		275	246	62	254	81	83	1.3 ✓	2.4	6.135	13
A 7	11:30	580	245	63	251	81	83	1.3 ✓	2.4	7.555	14
A 8		584	251	63	250	81	82	1.3 ✓	2.4	9.000	14
A 9		583	259	65	255	80	82	1.3 ✓	2.4	10.410	13
A 10	11:35	553	259	67	256	80	82	1.3 ✓	2.5	11.862	14
A 11		557	255	68	253	81	82	1.3 ✓	2.5	13.295	14
A 12		545	246	69	251	80	82	1.3 ✓	2.4	14.778	13
A 13	11:40	539	249	69	252	80	81	1.2 ✓	2.4	16.218	13
A 14		539	246	70	253	81	81	1.2 ✓	2.3	17.615	13
A 15		537	260	71	253	81	81	1.2 ✓	2.3	19.200	12
A 16	11:45	531	249	71	252	81	81	1.2 ✓	2.3	20.424	12
A 17		525	257	72	252	81	81	1.2 ✓	2.2	21.867	12
A 18		522	247	72	251	81	81	1.1 ✓	2.1	23.202	11
	11:50					Average	Average			24.538	
		Average				—	—		Average	Total	
		—				Average —			—	24.446	

EOF

No Punch
PLANT *Phelps-Dodge, Ajo Arizona*
LOCATION *Reverb ESP Outlet*
STACK DIAMETER (IN.) *72*
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE *7/30/76*
TIME *11:55 am*
RUN *12*

4,02 OPERATORS *Knirck*

4,03
STATIC PRESSURE (IN.WG.) *-2.7*
AMBIENT PRESSURE (IN.HG.) *28.19*
TYPE S PITOT COEFFICIENT *0.811*

STACK PRESSURE (IN.HG.) *27.99*
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER *0015*
ORIFICE METER COEFFICIENT *0.681*
PROBE LENGTH (FT.) *10*
NOZZLE DIAMETER (IN.) *0.25*

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-18	11:55	493	231	72	252	79	80	0.9	1.7	24.538	8
B-17		505	238	70	252	80	81	1.0	1.8	25.708	9
B-16		505	247	69	251	80	80	1.1	2.1	26.952	10
B-15	12:00	506	260	68	251	80	80	1.2	2.2	28.280	11
B-14		511	246	68	252	80	80	1.3	2.4	29.666	12
B-13		512	257	68	251	80	80	1.3	2.5	31.080	13
B-12	12:05	528	247	67	250	80	79	1.4	2.6	32.526	15
B-11		546	247	66	250	81	80	1.4	2.7	34.015	16
B-10		571	260	65	250	81	80	1.5	2.9	35.520	18
B-9	12:10	580	254	65	250	81	80	1.5	2.9	37.173	17
B-8		578	253	65	251	82	80	1.3	2.5	38.628	14
B-7		578	250	64	251	82	80	1.3	2.5	40.100	14
B-6	12:15	310	250	64	249	82	80	1.2	2.5	41.554	13
B-5		108	250	63	250	82	80	1.0	2.2	42.947	12
B-4		90	255	63	255	82	80	0.8	1.6	44.300	10
B-3	12:20	88	245	63	256	82	80	0.7	1.4	45.538	9
B-2		88	248	64	255	82	81	0.7	1.4	46.641	7
B-1		89	257	64	252	82	81	0.8	1.5	47.740	7
	12:25									48.890	
		Average 463.61				Average 80.472	Average 81.111		Average [illegible]	Total [illegible]	
						Average 81.(41)					

EOF
θ=60
+460
=[illegible]
=541.08

HJO, REVERB ESP
RUN 12
7/30/76

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{lc} \left(\frac{\rho H_2O}{M_{H_2O}}\right) \left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474\ (98.4)$$

$$= 4.6642\ \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (32.658) \left(\frac{28.19 + \frac{1.647}{13.6}}{560.86}\right)$$

$$= 24.1945.\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{4.6642}{4.6642 + 24.1945}$$

$$= .13975$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (5.833) + 0.32\ (11.583) + 0.28\ (82.584 + 0) + 0.64\ (0)$$

$$= 29.3946 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 29.3946(1- .13995) + 18\ (.13995)$$

$$= 27.825 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_pC_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_sM_s}}$$

/

$$= 85.48 \text{ X } .811 \text{ X } .98999 \sqrt{\frac{863.59}{(29.99)\ (27.825)}}$$

$$= 72.122 \text{ ft/sec}$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1- .19945)\ (72.122)(28.2943) \left(\frac{530}{863.611}\right)\left(\frac{29.99}{29.92}\right)$$

= 3,6[illegible] 079 scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

= ft³

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ ([illegible].9006)\left(\frac{28.14 + \frac{2.197}{13.6}}{541.042}\right)$$

= [illegible]5.146 ft³

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$= \frac{2396.66}{45.126} (2.205 \times 10^{-6})$ $\frac{2427.52}{45.1[illegible]}$ $(2.205 \times 10^{-6}$ $\frac{[illegible]92}{[illegible]}$ 2.205×10^{-6}

$= 1.1663 \times 10^{-4}$ lb/ft³ $= 1.1843 \times 10^{-4}$ $= 1.2[illegible]$

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

$= (3,634,079)(1.1663 \times 10^{-4})$ $(3,634,079)$ [illegible] 10^{-4}

= 423.8584 lb/hr $= 430.34$ [illegible]

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\overset{863.11}{\quad}) \left\{ 0.00267\ (98.4) + \frac{48.7006}{541.042} \left(28.19 + \frac{2.197}{13.6} \right) \right\}}{(60)\ (72.122)(27.99)(3.4088 \times 10^{-4})}$$

$$= 98.1146$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(6.80 - .05)(.01331)\left(\frac{435}{10}\right)}{45.196}$$

$$= 9.3384 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (3,\text{[illegible]}.44)(9.3384 \times 10^{-6})$$

$$= 33.4482\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(15.65 - .05)(.0419)\left(\frac{410}{5}\right)}{45.141}$$

$$= 1.3806 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (36,354,094)(1.3806 \times 10^{-4})$$

$$= 5.0192 \times 10^{3} \text{ lb/hr.}$$

Main Stack

0,0 [PLANT Phelps-Dodge, Ajo Arizona
LOCATION Mainstack

0,1 [STACK DIAMETER (IN.) 233

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/20/76
TIME 4:22 pm
RUN 1

1,2 [OPERATORS Rice

1,3 [STATIC PRESSURE (IN. WG.) − 0.5
AMBIENT PRESSURE (IN. HG.) 28.23
TYPE S PITOT COEFFICIENT 0.721

1OF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	350	350	398.4
Initial	350	350	381.8
Liquid Collected	0	0	16.6
			Total, $V_{\ell c}$
			16.6

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
4:20	127.278	3.4	103	103	0.13	260
4:27.48	133.76	3.9	103	103	0.15	262
4:39.	146.05	3.73	103	103	0.14	261
4:40	146.992	1.3	100	100	0.14	259
4.44:42	150.40	1.4	100	100	0.15	259
5.00	162.752					
	Total, V_m	Average	Avg., T_m			
	[illegible]	[illegible]	[illegible]			

EOF
EOF

No Punch
PLANT Phelps - Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) x (IN.)

2,1 DATE 7/20/76
TIME 4:22 pm
RUN 1

2,2 OPERATORS Rice

2,3 STATIC PRESSURE (IN. WG.) − 0.5
AMBIENT PRESSURE (IN. HG.) 28.27
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2,5 B

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
4:22:18	1.02	0.12	260
4:29	1.14	0.15	261
4:39:48	1.10	0.14	261
4:41	1.06	0.13	261
4:55:54	1.14	0.14	261

EOF

2,6

CO2 (% by Vol.)	O2 (% by Vol.)	CO (% by Vol.)
1.2	17.7	0.1
1.2	17.6	0.1
1.2	17.6	0
Average	Average	Average
1.2	17.667	0.0667

EOF
EOF

No Punch

PLANT Phelps - Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/20/76
TIME 4:17 pm
RUN 1

4,02 OPERATORS Stanley

4,03
STATIC PRESSURE (IN.WG.) - 0.5
AMBIENT PRESSURE (IN.HG.) 28.23
TYPE S PITOT COEFFICIENT 0.751

STACK PRESSURE (IN.HG.) 28.19
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	4:17	138	181		245	99	99	0.035	0.90	113.364	7
A-2		226	183		239	100	99	0.085	2.2	114.640	10
A-3		251	186		240	100	99	0.115	3.0	115.400	
A-4	4:22	253	186		245	99	100	0.115	3.0	117.550	
A-5		252	185		243	99	100	0.126	3.2	118.790	13
A-6		255	186		240	99	100	0.120	3.1	120.57	14
A-7	4:27	253	184		244	99	100	0.125	3.1	122.34	14
A-8		252	187		244	99	100	0.145	3.7	124.08	15
A-9		253	232		243	99	99	0.115	3.0	125.93	15
A-10	4:32	252	274		243	99	99	0.135	3.5	127.77	15
A-11		252	274		243	99	99	0.115	3.0	129.60	15
A-12	4:37	253	245		245	99	99	0.120	3.1	131.39	15
										134.186	
						99.8333	99.5833				
		Average				Average	Average		Average	Total	
						Average					

EOF

No Punch

PLANT *Phelps Dodge, Ajo Arizona*
LOCATION *Mainstack*
STACK DIAMETER (IN.) *353*
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE *7/20/76*
TIME *5.34 pm*
RUN *1*

4.02 OPERATORS *Stanley*

4.03
STATIC PRESSURE (IN.WG.) *−0.5*
AMBIENT PRESSURE (IN.HG.) *28.23*
TYPE S PITOT COEFFICIENT *0.757*

4.07
STACK PRESSURE (IN.HG.) *28.19*
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER *0039*
ORIFICE METER COEFFICIENT *0.698*
PROBE LENGTH (FT.) *10*
NOZZLE DIAMETER (IN.) *0.4375*

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp		Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
						Inlet (°F)	Outlet (°F)				
C-1	5:34	217	212		229	96	97	0.010	0.25	133.560	5
C-2		247	237		219	95	97	0.03	0.80	134.200	6
C-3		253	244		209	95	96	0.065	1.70	134.99	9
C-4	5.39	254	241		213	95	96	0.050	1.30	136.23	9
C-5		251	240		229	95	95	0.055	1.4	137.45	
C-6		252	241		252	95	96	0.030	0.80	138.69	
C-7	5.44	251	242		292	95	96	0.065	1.70	139.71	7
C-8		252	246		312	95	96	0.050	1.3	140.91	8
C-9		251	246		308	95	95	0.040	1.0	142.11	7
C-10	5.49	251	245		296	95	95	0.050	1.3	143.18	8
C-11		251	247		280	95	95	0.035	0.9	144.33	7
C-12	5.54	254	247		263	96	95	0.050	1.3	145.33	8
										146.450	
		Average				Average	Average		Average	Total	
						Average					

EOI

:20

2.023

244.75

17.7768

√ΔP .690

32.712 / 1002

32.647

460

704.75

No Punch
PLANT Phelps - Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/20/76
TIME
RUN 1

4,02 OPERATORS Stanley

4,03
STATIC PRESSURE (IN.WG.) −0.5
AMBIENT PRESSURE (IN.HG.) 28.23
TYPE S PITOT COEFFICIENT 0.751

4,07
STACK PRESSURE (IN.HG.) 28.19
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-1											
		Average				Average	Average		Average	Total	
						Average					

EOF

Traverse B port not run.

Ajo Mainstack Run 1

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho H_2O}{M_{H_2O}}\right) \left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\,(16.6)$$

$$= 0.7868\ \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,(34.609) \left(\frac{28.23 + \frac{2.746}{13.6}}{101.8 + 460}\right)$$

$$= 31.020\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{0.7868}{0.7868 + 31.020}$$

$$= 0.02474$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

81 [illegible]

$$= 0.44\ (1.2) + 0.32\ (17.667) + 0.28\ (\quad + 0) + 0.64\ (\quad)$$

0.528 + 5.653 + 22.717

= 28.898 lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.898\ (1-0.02[illegible]) + 18\ (0.02[illegible])$$

= 28.62[illegible] lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_pC_p\left(\sqrt{\Delta P}\right)_{avg}\sqrt{\frac{T_{s,avg}}{P_sM_s}}$$

/

$$= 85.48\ X\ 0.751\ X\ .2[illegible]\ \sqrt{\frac{[illegible]}{28.19\ (2[illegible].628)}}$$

= 16.[illegible] ft/sec

$$Q_s = 3600\,(1 - B_{wo})\,V_{s,avg}\,A\left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\,(1-0.02474)\,(16.137)\,(349.115)\left(\frac{530}{244.75 + 460}\right)\left(\frac{28.19}{29.92}\right)$$

$$= 1.4015 \times 10^7 \text{ scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\,V_{1c}$$

$$= 0.0474$$

$$= \quad \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,(32.647)\left(\frac{28.33 + \frac{2.023}{13.6}}{97.7705 + 460}\right)$$

$$= 17.417 \text{ ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$=$$

5. Concentration of Particulate Matter

at 0 sec

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$$= \frac{542.12}{29.417} (2.205 \times 10^{-6})$$

$= 4.0680 \times 10^{-5}$ lb/ft^3

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

$= (1.4015 \times 10^7)(4.0680 \times 10^{-5})$

$= 570.137$ lb/hr

1st reading

$\frac{546.93}{29.417}$ (2.205 × 10^{-6})

$= 4.0995 \times 10^{-5}$

$(1.4015 \times 10^7)(4.0995 \times 10^{-5})$

$= 574.544$ lb/hr

[illegible]

$\frac{785.[illegible]}{29.417}$ (2.205 × 10^{-6})

$= 5.8844 \times 10^{-5}$

$(1.4015 \times 10^7)(5.8844 \times 10^{-5})$

$= 82[illegible]$ lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\overset{104.15}{\quad}) \left\{ 0.00267\ (16.6) + \frac{32.647}{557.771} \left(28.23 + \frac{2.003}{13.6} \right) \right\}}{(40)\ (1.139)(29.14)(1.0434 \times 10^{-2})}$$

$$= 1.0548 \times 10^{2}$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(11.60 - .05)(.0130)\left(\frac{285}{100}\right)}{29.419}$$

$$= 1.5911 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (1.4015 \times 10^{7})(1.5911 \times 10^{-6})$$

$$= 22.0185\ \text{lb/hr}$$

10. **Concentration of Sulfur Dioxide**

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(4.50 - .05)(.115)\left(\frac{340}{3.6}\right)}{29.419}$$

$$= 3.4343 \times 10^{-4} \text{ lb/ft}^3$$

11. **Emission Rate of Sulfur Dioxide**

$$ER = Q_s C_{SO_2}$$

$$= (1.4015 \times 10^{7})(3.4343 \times 10^{-4})$$

$$= 5.5201 \times 10^{3} \text{ lb/hr.}$$

0,0 [PLANT Phelps - Dodge, Ajo Arizona
LOCATION Mainstack

0,1 [STACK DIAMETER (IN.) 253

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/21/76
TIME 5:20 pm
RUN 2

1,2 [OPERATORS Rice

1,3 [STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.16
TYPE S PITOT COEFFICIENT 0.771

10F

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	350	350	307.8
Initial	350	350	298.95
Liquid Collected	0	0	8.85
			Total, V_{lc}
			8.85

EOF

1,6

	Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
	5:20	163.975	1.28	94	95	0.12	250
A	5:21:30	164.000	1.28	94	95	0.12	253
	5:29:33	170.800	1.28	94	95	0.12	253
	5:47	184.041					
	7:15	184.290	1.50	91	91	0.14	248
B	7:19	186.350	1.50	90	92	0.14	250
	7:22	189.34	1.50	90	91	0.14	247
	7.26	192.44	1.60	90	91	0.15	248
	7.27:42	193.38					

Total, V_m	Average	Avg., T_m
29.156	1.42	92.643 + 460

EOF
EOF

1.026 28.445

= 552.643

237<

No Punch
PLANT *Phelps Dodge, Ajo Arizona*
LOCATION *Mainstack*
STACK DIAMETER (IN.) *253*
DUCT DIMENSIONS (IN.) x (IN.)

2.1
DATE *7/21/76*
TIME *5:21 pm*
RUN *2*

2.2 OPERATORS *Rice*

2.3
STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) *26.16*
TYPE S PITOT COEFFICIENT *0.771*

STACK GAS MOLECULAR WEIGHT

2.5

	Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
	521:30	3.26	0.14	252
A	5:25:24	3.02	0.12	253
	5:30:12	3.02	0.12	253
	7:15:48	3.49	0.16	245
B	7:18:30	3.26	0.14	247
	7:22:36	3.36	0.15	245
	7:26:48	3.38	0.15	249

EOF

2.6

CO$_2$ (% by Vol.)	O$_2$ (% by Vol.)	CO (% by Vol.)
1.6	17.6	0
1.6	17.5	0
1.6	17.6	0
Average	Average	Average
1.6	17.567	

EOF
EOF

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/21/76
TIME 7:10 pm
RUN 2

4,02 OPERATORS Stanley

4,03
STATIC PRESSURE (IN.WG.) - 0.5
AMBIENT PRESSURE (IN.HG.) 28.16
TYPE S PITOT COEFFICIENT 0.751

STACK PRESSURE (IN.HG.) 28.12
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10'
NOZZLE DIAMETER (IN.) 7/16

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A 1	7.10	227	109		95	82	82	0.02	0.5	1[illegible].118	6
A-2		234	171		104	82	82	0.065	1.7	180.810	10
A-3		239	231		132	82	82	0.085	2.2	181.925	13
A 4	7:15	238	247		172	82	82	0.09	2.3	183.320	14
A-5		238	251		227	82	82	0.105	2.7	184.790	16
A-6		238	251		265	82	82	0.11	2.8	186.320	17
A-7	7.20	237	250		284	82	82	0.10	2.6	187.910	16
A-8		236	252		275	83	82	0.09	2.3	189.470	15
A-9		238	250		264	83	82	0.10	2.6	190.980	15
A-10	7.25	237	251		253	83	82	0.10	26	192.500	16
A-11		236	251		255	84	82	0.11	2.8	194.040	16
A 12		237	252		257	84	82	0.10	2.6	195.610	16
	7:30									199.192	
		Average				Average 82.583	Average 82		Average	Total	
						Average					

EOF

82.2916 2.308 19.074

No Punch

PLANT *Phelps - Dodge Ajo Arizona*
LOCATION *Main Stack*
STACK DIAMETER (IN.) *25 3*
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE *7/21/76*
TIME *5:20 pm*
RUN *2*

4,02 OPERATORS *Stanley*

4,03
STATIC PRESSURE (IN.HG.)
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT

STACK PRESSURE (IN.HG.)
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER
ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4,06

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-1	5:20	194	251		249	86	87	0.015	[illegible]	[illegible]	[illegible]
B-2		225	251		247	86	87	0.035	[illegible]	[illegible]	4
B-3		242	252		247	86	87	0.085	2.2	[illegible]	[illegible]
B-4	5:25	246	252		246	86	87	0.09	2.3	152.88	[illegible]
B-5		246	250		245	86	87	0.095	[illegible]	[illegible]	4
B-6		245	249		246	86	87	0.010	[illegible]	155.420	[illegible]
B-7	5:30	246	250		248	86	87	0.085	2.2	157.310	[illegible]
B-8		248	250		247	86	87	0.10	2.6	[illegible]	15
B-9		246	250		246	86	86	0.10	2.6	160.310	15
B-10	5:35	246	250		242	86	86	0.07	[illegible]	161.910	15
B-11		246	250		240	86	86	0.10	2.6	164.320	15
B-12		246	252		252	86	86	0.09	2.3	164.890	15
	5:40									166.367	
		Average				Average	Average		Average	Total	
						[illegible]	[illegible]				
						Average					

[illegible]

255 16

2.125

EOF

No Punch

PLANT *Phelps - Dodge, Ajo Arizona*
LOCATION *Main Stack*
STACK DIAMETER (IN.) *25.3*
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE *7/21/76*
TIME *6:12 pm*
RUN *2*

4.02 OPERATORS *Stanley*

4.03
STATIC PRESSURE (IN.WG.)
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT

STACK PRESSURE (IN.HG.)
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER
ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
C-1	6:12	183	232		221	84	84	0.01	0.4	166.507	5
C-2		204	244		217	84	84	0.04	1.1	167.170	8
C-3		235	247		225	84	84	0.02	0.5	168.160	6
C-4	6:17	240	239		242	84	84	0.05	1.3	169.166	8
C-5		243	247		253	84	84	0.065	1.7	170.180	10
C-6		245	248		251	83	84	0.06	1.5	171.390	10
C-7	6:22	244	248		243	83	84	0.065	1.7	172.640	10
C-8		244	248		240	83	84	0.045	1.2	173.900	9
C-9		244	248		240	84	84	0.05	1.3	175.050	9
C-10	6:27	240	248		242	83	84	0.07	1.8	176.180	11
C-11		239	248		245	83	84	0.065	1.7	177.440	11
C-12		238	247		244	83	84	0.065	1.7	178.130	11
	6:32									180.023	
		Average [illegible]				Average 83.5	Average 84		Average	Total	
						Average					

EOF

+460
[illegible]

83.75

1.325 13.616

9.6 84.125 + 460
= 544.125

TOTAL V = 45.[illegible]
correction factor V = 1.002

[illegible] = [illegible]052

V_m corrected = 45.[illegible]

241<

Ajo Mon [illegible] Run

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho H_2O}{M_{H_2O}}\right) \left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (8.45)$$

$$= .4145\ \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (28.445) \left(\frac{28.16 + \frac{1.42}{13.6}}{552.643}\right)$$

$$= 25.964\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{.4145}{.4145 + 25.964}$$

$$= .01602$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (\text{[illegible]}) + 0.32\ (\text{[illegible]}) + 0.28\ (\text{[illegible]} + 0) + 0.64\ (0)$$

$$= \text{[illegible]}\ \text{lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= \text{[illegible]}\ (1- \text{[illegible]}) + 18\ (\text{[illegible]})$$

$$= \text{[illegible]}\ \text{lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \times \text{[illegible]} \times (\text{[illegible]}) \sqrt{\frac{696.789}{(28.12)(28.783)}}$$

$$= \text{[illegible]}\ \text{ft/sec}$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .01602)\ ([illegible])(349115)\left(\frac{530}{[illegible]}\right)\left(\frac{28.12}{29.92}\right)$$

$$= 1.5469 \times 10^7 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= \quad ft^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ ([illegible])\left(\frac{28.16 + \frac{1.919}{13.6}}{29.125 [illegible]}\right)$$

$$= 44.250\ ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$=$$

5. Concentration of Particulate Matter

at 0 sec	1st reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{807.50}{44.95} (2.205 \times 10^{-6})$	$\frac{809.60}{44.95} (2.205 \times 10^{-6})$	$\frac{1118.10}{44.95} (2.205 \times 10^{-6})$
$= 3.4611 \times 10^{-5}$ lb/ft³	$= 3.9715 \times 10^{-5}$	$= 5.4848 \times 10^{-5}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (1.3964 \times 10^{7})(3.4611 \times 10^{-5})$	$(1.3969 \times 10^{7})(3.9715 \times 10^{-5})$	$(1.3969 \times 10^{7})(5.4848 \times 10^{-5})$
$= 553.$[illegible] lb/hr	$= 554.772$ lb/hr	$= 766.1645$ lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\,T_s \left\{0.00267\,V_{1c} + \frac{V_m}{T_m}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right\}}{\Theta V_s\,P_s\,A_n}$$

$$= \frac{(1.667)(\text{[illegible]})\left\{0.00267\,(\text{[illegible]}) + \frac{\text{[illegible]}}{\text{[illegible]}}\left(\text{[illegible]} + \frac{\text{[illegible]}}{13.6}\right)\right\}}{(\text{[illegible]})\,(\text{[illegible]})(\text{[illegible]})(\text{[illegible]})}$$

$= \text{[illegible]} \times 10^2$

8. Concentration of Sulfur Trioxide/Acid Mist

Main Stack

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\,\frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\,\frac{(\text{[illegible]})(0.0130)\left(\frac{260}{100}\right)}{\text{[illegible]}}$$

$= 1.178 \times 10^{-7}$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$ER = Q_s\,C_{H_2SO_4}$

$= (1.3\text{[illegible]}69 \times 10^{\text{[illegible]}})(1.178 \times 10^{\text{[illegible]}})$

$= 1.6456$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(28.40 - .05)(.1115)\left(\frac{465}{5}\right)}{44.950}$$

$$= 4.6107 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (1.3969 \times 10^7)(4.6107 \times 10^{-4})$$

$$= 6.4408 \times 10^3 \text{ lb/hr.}$$

0,0 PLANT Phelps-Dodge, Ajo Arizona
LOCATION Mainstack
0,1 STACK DIAMETER (IN.) 253
0,2 DUCT DIMENSIONS (IN.) x (IN.)

1,0
1,1 DATE 7/22/76
TIME 10:35 am
RUN 3
1,2 OPERATORS Rice
1,3 STATIC PRESSURE (IN. WG.) - 0.5
AMBIENT PRESSURE (IN. HG.) 28.18
TYPE S PITOT COEFFICIENT 0.771
1OF

1,4 WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	352	350	398.1
Initial	350	350	384.7
Liquid Collected	2	0	13.4
			Total, $V_{\ell c}$
			15.4

EOF

A
1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	.elocity Head (in. wg.)	Stack Gas Temp (°F)
10:35	193.542	1.28	91	90	0.12	238
10:44:24	200.60	1.28	91	91	0.12	239
10:54:51	208.20	1.28	92	92	0.12	236
11:00:00	211.83	1.12	93	92	0.11	238
11:08	217.70	1.39	94	93	0.13	241
11:18:24	225.252					

Total, V_m	Average	Avg., T_m
	1.27	

EOF
EOF

$\frac{V_m}{1.025}$

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) x (IN.)

2,1 DATE 7/22/76
TIME 10.35 am
RUN 3

2,2 OPERATORS Rice

2,3 STATIC PRESSURE (IN. HG.) -0.50
AMBIENT PRESSURE (IN. HG.) 28.18
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2,5 A

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
10:35:30	4.5	0.13	237
10:44:54	4.5	0.12	237
10:55:18	4.5	0.12	238
11:00:54	3.0	0.10	240
11:09:06	3.25	0.14	239

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
1.5	16.7	0
1.4	16.7	0
1.4	16.7	0
Average	Average	Average
1.433	16.7	0

EOF
EOF

No Punch
PLANT Phelps-Dodge, Ajo Arizona
LOCATION Main Stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/22/76
TIME 9:55 am
RUN 3

4.02 OPERATORS Stanley

4.03
STATIC PRESSURE (IN.WG.) -0.5
AMBIENT PRESSURE (IN.HG.) 28.18
TYPE S PITOT COEFFICIENT 0.751

STACK PRESSURE (IN.HG.) 28.14

4.07 MOLECULAR WEIGHT (LB/LB-MOLE)

B_{wo}

4.05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT ~~[illegible]~~ 0.648
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 7/16

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	9:55	154	251		249	84	83	0.50	5	208 618	18
A-2		239	250		246	84	83	0.50	5	210 520	22
A-3		239	250		247	85	83	0.55	5	212 750	22
A-4	10:00	240	250		248	85	83	0.55	5	214 850	22
A-5		241	251		250	86	83	0.55	5	217 040	22
A-6		241	252		250	87	84	0.07	1.8	219 610	9
A-7	10:05	242	250		249	87	84	0.095	2.5	220 920	9
A-8		242	251		249	87	84	0.065	1.7	222 410	8
A-9		2[illegible]	250		249	87	84	0.090	2.3	223 760	5
A-10	10:10	239	252		251	88	84	0.095	2.5	225 110	7
A-11		240	322		250	88	84	0.065	1.7	226 670	5
A-12		242	251		244	88	84	0.075	1.9	227 990	5
	10:15									229.294	
		Average				Average	Average		Average	Total	
						Average					

EOF 0:20 83 29.4 20

84.9583

No Punch

PLANT *Phelps Dodge, Ajo Arizona*
LOCATION *Main Stack*
STACK DIAMETER (IN.) *253*
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE *7/22/76*
TIME *10:29 am*
RUN *3*

4.02 OPERATORS *Stanley*

4.03
STATIC PRESSURE (IN.HG.)
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT

4.07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER
ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B 1	10:29	228	243		193	87	85	0.075	1.9	229.431	8
B 2		228	250		236	87	85	0.090	2.3	230.700	9
B 3		232	251		271	88	85	0.090	2.3	232.130	9
B 4	10:34	229	252		285	88	85	0.105	2.7	233.590	9
B 5		231	249		281	88	85	0.105	2.7	235.120	9
B 6		232	250		272	89	85	0.130	3.4	236.680	11
B 7	10:39	236	249		261	89	85	0.110	2.8	238.360	10
B 8		233	250		251	90	86	0.110	2.8	240.040	10
B 9		235	250		239	90	86	0.115	3.0	241.650	10
B 10	10:44	233	250		229	90	86	0.10	2.6	243.290	10
B 11		231	249		230	87	86	0.11	2.8	244.850	10
B 12		231	250		244	91	86	0.105	2.7	246.470	10
[illegible]	10:49										
		Average				Average	Average		Average	Total	
						Average					

EOF

88.6 85.416 320 17.039

87.0416 2.6

No Punch

PLANT *Phelps-Dodge, Ajo Arizona*
LOCATION *Main Stack*
STACK DIAMETER (IN.) *25 3*
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE *7/22/76*
TIME *11:00 am*
RUN *3*

4.02 OPERATORS *Stanley*

4.03
STATIC PRESSURE (IN.HG.)
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT

4.07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER
ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
C-1	11:00	239	216		190	91	88	0.015	1.0	248.140	6
C-2		232	242		223	91	89	0.045	1.2	249.[illegible]	6
C-3		232	246		263	91	89	0.070	1.8	250.230	7
C-4	11:05	236	248		272	92	89	0.090	2.3	251.480	9
C-5		236	248		266	92	90	0.085	2.2	252.880	9
C-6		235	247		257	93	90	0.075	1.9	254.340	8
C-7	11:10	234	249		248	93	90	0.075	1.9	255.220	8
C-8		235	248		240	93	91	0.100	2.6	257.060	9
C-9		235	247		242	94	91	0.075	1.9	258.550	8
C-10	11:15	235	249		248	95	92	0.080	2.1	259.980	8
C-11		235	249		250	95	92	0.085	2.2	261.360	8
C-12		236	244		249	96	93	0.080	2.1	262.780	8
	11:20									264.184	
		Average				Average	Average		Average	Total	
						Average					

0-20 +44.0
20 60 =693

[illegible] 90.3 2.32 16.044

91.6

Correction factor Yo / 1.002
53.542

[illegible] Run 3

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{lc} \left(\frac{\rho\, H_2O}{M_{H_2O}}\right) \left(\frac{R\, T_{std}}{P_{std}}\right)$$

$$= 0.0474\, V_{lc}$$

$$= 0.0474\ (15.4)$$

$$= .72996\ \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (30.937) \left(\frac{28.16 + \frac{1.24}{13.6}}{551.4}\right)$$

$$= 28.068\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{.72996}{.72996 + 28.068}$$

$$= .02535$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

= 0.44 ([illegible]) + 0.32 ([illegible]) + 0.28 ([illegible] + 0) + 0.64 ([illegible])

= 28.897 lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

= 28.897 (1- .02535) + 18 (.02535)

= 28.621 lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_pC_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_sM_s}}$$

/

$$= 85.48 \text{ X } .[illegible] \text{ X } (.3531) \sqrt{\frac{693.}{(28.14)(28.621)}}$$

= 21.026 ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .02535)\ (21.020)(349.115) \left(\frac{530}{693.}\right) \left(\frac{28.14}{29.92}\right)$$

$$= 1.8526 \times 10^7 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (0)$$

$$V_{W\ STD} = 0 \quad ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (53.592) \left(\frac{28.15 + \frac{2.035}{13.6}}{87.889 + 460}\right)$$

$$= 49.151\ ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

B_{wo} = 0

5. Concentration of Particulate Matter

[illegible]

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$= \frac{[illegible].41}{44.151} (2.205 \times 10^{-6})$ $\frac{432.41}{44.151} (2.205 \times 10^{-6})$ $\frac{[illegible]}{44.[illegible]}$ [illegible]

$= 4.1852 \times 10^{-5}$ lb/ft³ $= 4.1942 \times 10^{-5}$ $= 6.0360 \times 10^{-5}$

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

$= (1.8526 \times 10^{7})$ $(1.8526 \times 10^{7})(4.1942 \times 10^{-5})$ $(1.8526 \times 10^{7})(6.0360 \times 10^{-5})$

= 775.3497 lb/hr = 777.0120 lb/hr = 1118.2289 lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(645) \left\{ 0.00267\ (15.4) + \frac{53.592}{87.884 + 460} \left(28.18 + \frac{2.628}{13.6} \right) \right\}}{(60)\ (21.026)(28.14)(1.0439 \times 10^{-3})}$$

$= 49.999$

8. Concentration of Sulfur Trioxide/Acid Mist

Main stack

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(5.20 - 0.05)(0.0107)\left(\frac{286}{100}\right)}{49.151}$$

$= 3.463 \times 10^{-7}$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$= (1.8526 \times 10^{7})(3.463 \times 10^{-7})$

$= 6.4156$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(22.80 - .05)(.0097)\left(\frac{600}{\text{[illegible]}}\right)}{49.151}$$

$$= 4.4138 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (1.8526 \times 10^{7})(4.4138 \times 10^{-4})$$

$$= 8.179 \times 10^{3} \text{ lb/hr.}$$

0,0 [PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack

0,1 [STACK DIAMETER (IN.) 253

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/23/76
TIME 10:50 am
RUN 4

1,2 [OPERATORS Rice

1,3 [STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.25
TYPE S PITOT COEFFICIENT 0.771

1OF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	465	242	300.0
Initial	350	350	288.7
Liquid Collected	115	-108	11.3
			Total, V_{lc}
			18.3

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F)		Velocity Head (in. wg.)	Stack Gas Temp (°F)
			in	out		
10:50	225.569	1.12	87	86	0.11	266
11:00:36	232.83	1.39	88	87	0.13	268
11:07:00	237.755	1.28	90	88	0.12	263
11:22:48	249.315	1.28	90	89	0.12	272
11:29:36	254.20	1.28	91	90	0.12	269
11:35:12	261.30	1.39	91	90	0.13	269
11:42:51	267.671					

EOF
EOF

Total, V_m	Average	Avg., T_m
42.102	1.29	88.917 + 460

= 548.917

$\frac{V_m}{1.025}$ = 41.075

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) x (IN.)

2.1 DATE 7/23/76
TIME 10:54 am
RUN 4

2.2 OPERATORS Rice

2.3 STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.25
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2.5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
10:54	3.02	0.12	266
11:02:18	3.14	0.13	261
11:08:54	3.14	0.13	264
11:24:12	3.02	0.12	274
11:30:54	2.75	0.10	270
11:40:54	3.02	0.12	269

EOF

2.6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
1.9	17.1	0
1.9	17.1	0.1
2.0	17.1	0.1
Average	Average	Average
1.933	17.1	.0667

EOF
EOF

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/23/76
TIME 9.02 am
RUN 4

4.02 OPERATORS Stanley

4.03
STATIC PRESSURE (IN.WG.) − 0.5
AMBIENT PRESSURE (IN.HG.) 28.25
TYPE S PITOT COEFFICIENT 0.751

4.07
STACK PRESSURE (IN.HG.) 28.21
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	[illegible]	212	247		251	82	83	0.145	1.2	272.888	8
A-2		222	247		250	83	83	0.165	1.7	274.040	9
A-3		233	247		252	83	83	0.095	2.5	275.260	11
A-4	9:12	237	248		252	83	83	0.095	2.5	276.690	11
A-5		241	247		252	83	83	0.105	2.7	278.210	12
A-6		243	246		253	83	83	0.100	2.6	279.755	12
A-7	[illegible]	247	246		253	84	83	0.105	2.7	281.310	12
A-8		247	246		251	85	83	0.105	2.7	282.860	12
A-9		175	248		250	85	83	0.105	2.7	284.440	12
A-10	9:23	246	248		253	86	84	0.110	2.8	286.010	13
A-11		246	248		252	86	84	0.100	2.6	287.580	12
A-12		247	249		248	86	84	0.115	3.0	289.145	13
										290.744	
	9:27										
		Average				Average	Average		Average	Total 17.856	
						Average					

$\frac{V_m}{1.002}$

No Punch

PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/23/76
TIME 9:40 am
RUN 4

4,02
OPERATORS Stanley

4,03
STATIC PRESSURE (IN.WG.) − 0.5
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT 0.751

4,07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-1	9:40	165	242		166	85	84	0.015	0.7	286.741	6
B-2		211	247		211	86	83	0.050	1.3	2[illegible]1.665	7
B-3		254	246		259	86	84	0.100	2.6	292.075	12
B-4	9:45	262	244		246	84	84	[illegible]	1.7	294.2[illegible]	
B-5	[illegible]	262	246		254	87	86	0.125	3.2	295.035	15
B-6		261	246		257	84	85	0.115	3.0	296.516	16
B-7	10:03	262	247		257	89	85	0.115	3.0	298.180	17
B-8		262	246		256	90	86	0.140	3.6	299.776	17.21
B-9		261	246		254	91	86	0.125	3.2	301.5[illegible]	22
B-10	10:08	261	247		253	92	86	0.115	3.0	3[illegible]5.2[illegible]	19
B-11		262	246		257	92	87	0.120	3.1	3[illegible]7.4[illegible]	18
B-12		262	245		254	93	86	0.125	3.2	306.6[illegible]	18
										30[illegible].378	
	10:13										
		Average				Average	Average		Average	Total	
						Average				[illegible] 637	

.30

EUT

No Punch

PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 25.3
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/23/76
TIME 10:23 am
RUN 4

4.02 OPERATORS Stanley

4.03
STATIC PRESSURE (IN.WG.) -0.5
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT 0.751

4.07
STACK PRESSURE (IN HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
C 1	10:23	261	224		168	96	92	0.035	0.9	308.500	7
C 2		270	243		211	97	93	0.045	1.2	309.440	8
C 3		270	247		248	98	94	0.040	1.1	310.480	8
C 4	10:28	269	248		272	99	94	0.080	2.1	311.550	8
C 5		267	249		279	100	96	0.090	2.3	312.750	12
C 6		270	248		275	100	97	0.065	1.7	314.220	11
C 7	10:33	270	248		270	99	96	0.075	1.9	315.520	11
C 8		270	247		263	100	96	0.075	1.9	316.840	11
C 9		271	248		249	99	98	0.070	1.8	318.200	
C 10	10:38	270	246		248	100	98	0.050	1.3	319.520	9
C 11		271	246		251	100	99	0.055	1.4	320.715	9
C 12		270	247		253	100	99	0.055	1.4	321.810	9
										323.016	
	10:43										
		Average 253.806				Average	Average		Average	Total 14.516	

D +460 =713.806

+460 559.364 (559 avg 289

17.856 + 17.663 + 14.516
50.035

$\frac{V_m}{1.002}$ 49.935

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho H_2O}{M_{H_2O}}\right) \left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (18.3)$$

$$= .8674\ ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (1.015)\ \left(\frac{[illegible] + \frac{[illegible]}{13.6}}{[illegible]}\right)$$

$$= 37.563\ ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{8674}{8674 + 37.563}$$

$$= 02257$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (1.933) + 0.32\ (17.1) + 0.28\ ([illegible] + 0) + 0.64\ (\quad)$$

$$= 28.993 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= [illegible]\ (1- [illegible]) + 18\ ([illegible])$$

$$= 28.686 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

$$= 85.48 \text{ X } [illegible] \text{ X } [illegible] \sqrt{\frac{713.306}{[illegible]\ ([illegible].686)}}$$

$$= [illegible] \text{ ft/sec}$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1- [illegible]9)\ ([illegible])(244.115)\left(\frac{530}{\underset{+460}{306}}\right)\left(\frac{28.21}{29.92}\right)$$

= 14,[illegible] scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

= ft³

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ ([illegible])\left(\frac{[illegible] + \frac{[illegible]}{13.6}}{89.361\quad 460}\right)$$

= 45.791 ft³

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 6 sec.	1st reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{[illegible]}{45.741} (2.205 \times 10^{-6})$	$\frac{841.57}{45.741} (2.205 \times 10^{-6})$	$\frac{1152.45}{45.741} (2.205 \times 10^{-6})$
$= 4.[illegible] \times 10^{-5}$ lb/ft³	$= 4.0564 \times 10^{-5}$	$= 5.5555 \times 10^{-5}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (14,9[illegible])(4.0463 \times 10^{-5})$	$(14,989,821)(4.0564 \times 10^{-5})$	$(14,989,821)(5.5555 \times 10^{-5})$
$= 6[illegible]75$ lb/hr	608.1205 lb/hr	= 832.[illegible] lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\, T_s \left\{ 0.00267\, V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\, P_s\, A_n}$$

$$= \frac{(1.667)(\text{[illegible]}) \left\{ 0.00267\, (\text{[illegible]}) + \frac{\text{[illegible]}}{\text{[illegible]}} \left(\text{[illegible]} + \frac{\text{[illegible]}}{13.6} \right) \right\}}{(\text{[illegible]})\,(17.48)(\text{[illegible]})(\text{[illegible]})}$$

$= 83.667$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(N\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(\text{[illegible]})(\text{[illegible]})\left(\frac{\text{[illegible]}}{\text{[illegible]}}\right)}{\text{[illegible]}}$$

$= \text{[illegible]} \times 10^{-6}$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\, C_{H_2SO_4}$$

$= (\text{[illegible]})(\text{[illegible]})$

$= \text{[illegible]}$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(\text{[illegible]}2.05 - .05)(.1001)\left(\frac{\text{[illegible]}}{5}\right)}{45.741}$$

$$= 4.2071 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (14,8\text{[illegible]}) (4.2071 \times 10^{-4})$$

$$= 6.\text{[illegible]}4 \times 10^{\text{[illegible]}} \text{ lb/hr.}$$

0,0 PLANT Phelps-Dodge, Ajo Arizona
LOCATION Mainstack

0,1 STACK DIAMETER (IN.) 353

0,2 DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 DATE 7/26/76
TIME 8:52 am
RUN 5

1,2 OPERATORS Rice

1,3 STATIC PRESSURE (IN. WG.) -0.55
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.771

1OF

1,4 WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	455	265	321.5
Initial	350	350	313.2
Liquid Collected	105	-85	8.3
			Total, $V_{\ell c}$
			28.3

EOF

1,6

A

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
8:52	267.834	1.12	88	87	0.11	244
9:03	275.09	1.12	88	87	0.[illegible]	243
9:26:30	287.39	1.12	90	89	0.1	248
9:31	293.685					

EOF
EOF

Total, V_m	Average	Avg., T_m
25.851	1.12	[illegible] 107

$\frac{V_m}{1.025}$ 22.220

80 Punch
PLANT Phelps - Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) x (IN.)

2,1
DATE 7/26/76
TIME 8:52 am
RUN 5

2,2 OPERATORS Rico

2,3
STATIC PRESSURE (IN. WG.) -0.55
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
8:52:30	2.89	0.11	243
9:03:20	2.89	0.11	243
9:26:50	2.89	0.11	248

EOR

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
1.6	17.4	0
1.7	17.3	0
1.7	17.3	0
Average	Average	Average

1.667 17.333

No Punch

PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 353
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/26/76
TIME 8:52 am
RUN 5

4,02 OPERATORS Stanley

4,03
STATIC PRESSURE (IN.WG.) −0.55
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.751

STACK PRESSURE (IN.HG.) 28.15
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
C-1	8:52	228	246		251	117	115	0.045	1.7	336.425	4
C-2		244	247		252	116	115	0.045	1.4	–	6
C-3		244	246		253	115	115	0.045	1.7	[illegible]	[illegible]
C-4	8:57	244	246		253	115	116	0.030	2.4	[illegible]	10
C-5		247	247		252	114	116	0.060	2.5	[illegible]	[illegible]
C-6		251	247		251	114	117	0.070	2.8	[illegible]	
C-7	[illegible]	253	247		252	114	117	0.060	2.5	[illegible]	[illegible]
C-8		258	248		254	115	118	0.075	2.7	[illegible]	
C-9		250	250		255	116	118	0.045	[illegible]	[illegible]	[illegible]
C-10	9:07	[illegible]	248		254	116	119	[illegible]	[illegible]	[illegible]	
C-11		248	249		254	117	119	0.045	[illegible]	[illegible]	[illegible]
C-12		247	248		254	117	120	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]									[illegible]	
		Average				Average	Average		Average	Total	
						Average					

T5

611

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 245.3
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/26/76
TIME 9:24 am
RUN 5

4,02 OPERATORS Stanley

4,03
STATIC PRESSURE (IN.WG.) -0.55
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT 0.251

4,07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4325

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. Hg.)
B-1	9:24	193	236		174	107	111	0.01	0.3	345.595	4
B-2		221	245		226	103	108	0.04	1.0	346.280	7
B-3		241	248		267	102	107	0.065	1.7	347.390	8
B-4	9:29	246	248		278	101	107	0.080	2.1	348.470	10
B-5		250	247		274	100	106	0.090	2.3	349.870	10
B-6		248	248		267	99	105	0.110	2.8	351.33	11
B-7	9:34	244	247		253	98	103	0.095	2.5	352.880	11
B-8		247	247		251	98	103	0.095	2.5	354.480	11
B-9		249	248		256	97	101	0.085	2.2	356.060	11
B-10	9:39	252	248		256	97	101	0.075	1.9	357.580	10
B-11		252	246		256	97	101	0.095	2.5	359.020	10
B-12		253	248		257	97	100	0.080	2.1	360.530	10
										361.995	
	9:44										
		Average				Average	Average		Average	Total	
						Average					

EOF

241.333 [illegible]

NO PUNCH
PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4.21
DATE 7/26/76
TIME 9:57 am
RUN 5

4.32 OPERATOR Stanley

4.33
STATIC PRESSURE (IN.HG.) - 0.55
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.751

STACK PRESSURE (IN.HG.) 28.15
4.27 MOLECULAR WEIGHT (LB/LB-MOLE)
F_{wo}

4.25
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.678
PROBE LENGTH (FT.) 20
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.38

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft³)	Pump Vacuum (in. hg.)
A-1	[illegible]	[illegible]	[illegible]		82	93	96	[illegible]	[illegible]	[illegible]	[illegible]
A-2		246	168		283	93	95	0.07	[illegible]	362.176	4
A-3		[illegible]	162		282	92	95	0.063	[illegible]	363.490	6
A-4	10:04	253	159		267	92	95	0.070	[illegible]	364.921	6
A-5		250	156		278	92	95	0.065	[illegible]	[illegible]	[illegible]
A-6		250	148		268	92	94	0.065	[illegible]	366.210	[illegible]
A-7	[illegible]	249	239		257	92	94	0.065	[illegible]	367.440	8
A-8		247	244		250	93	94	0.045	[illegible]	368.670	[illegible]
A-9		248	246		254	92	94	[illegible]	[illegible]	[illegible]	[illegible]
A-10	[illegible]	247	229		254	92	93	0.060	[illegible]	370.385	6
A-11		252	[illegible]		253	92	93	0.060	[illegible]	[illegible]	6
A-12		252	240		253	92	93	0.060	[illegible]	[illegible]	[illegible]
	10:17									373.831	
		Average				Average	Average		Average	Total	
						Average					

EOI 20 248.917

[illegible]

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho H_2O}{M_{H_2O}}\right) \left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474(28.3)$$

$$= 1.341\ \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ ([illegible]) \left(\frac{28.19 + \frac{1.12}{13.6}}{88.167 + 460}\right)$$

$$= 16.296\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{1.341}{1.341 + 16.296}$$

$$= .0760$$

2. Stack Gas Composition

$$M_d = 0.44\,(\%CO_2) + 0.32\,(\%O_2) + 0.28\,(\%N_2 + \%CO)$$

$$+0.64\,(\%SO_2)$$

$$= 0.44\,(\text{[illegible]}) + 0.32\,(\text{[illegible]}) + 0.28\,(\text{[illegible]} + 0) + 0.64\,(\quad)$$

[illegible] + [illegible] + [illegible]

= 28.[illegible] lb/lb-mole

$$M_s = M_d\,(1-B_{wo}) + 18\,B_{wo}$$

$$= 28.960(1-0.0498 + 18\,(\text{[illegible]})$$

= 28.[illegible] lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_pC_p\left(\sqrt{\Delta P}\right)_{avg}\sqrt{\frac{T_{s,avg}}{P_sM_s}}$$

/

$$= 85.48 \text{ X } 0.[illegible] \text{ X } 0.[illegible]\sqrt{\frac{[illegible]}{2[illegible])}}$$

= 14.2[illegible] ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - 0.06198)\ (14.258)\ (349.115) \left(\frac{530}{245.61 + 460}\right)\left(\frac{28.15}{29.92}\right)$$

$= 1.17$ [illegible] $\times 10$ [illegible] scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$= \quad ft^3$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (\text{[illegible]}) \left(\frac{23.19 + \frac{1.547}{13.6}}{103.861 + 460}\right)$$

$=$ [illegible] ft^3

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

[illegible]

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$= \frac{691.44}{[illegible]} (2.205 \times 10^{-6})$ [illegible]

$= 3.8619 \times 10^{-5}$ lb/ft³ = 3.883 × [illegible] = 5.[illegible]

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

$= (1.1877 \times 10^{7})$ $(1.1877 \times 10^{7})(3.883 \times 10^{-5})$ $(1.1877 \times [illegible])([illegible])$

= [illegible] lb/hr = 461.2803 lb/hr = [illegible] lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\text{[illegible]}) \left\{ 0.00267\ (\text{[illegible]}) + \frac{45.121}{\text{[illegible]}} \left(\text{[illegible]} + \frac{1.549}{13.6} \right) \right\}}{(\text{[illegible]})\ (\text{[illegible]})(\text{[illegible]})(\text{[illegible]} \times 10^{-2})}$$

[illegible] $\times 10^{2}$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(N\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(\text{[illegible]} - \text{[illegible]})(\text{[illegible]})\left(\frac{\text{[illegible]}}{\text{[illegible]}}\right)}{\text{[illegible]}}$$

$= 4.1148 \times 10^{-?}$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$= (\text{[illegible]})(4.1148 \times 10^{-7})$

$=$ 10.[illegible] lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(\text{[illegible]})(\text{[illegible]})\left(\frac{\text{[illegible]}}{\text{[illegible]}}\right)}{\text{[illegible]}}$$

$$= \text{[illegible]} \times 10^{-4}\ \text{lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= \text{[illegible]}$$

$$= \text{[illegible]} \times 10^{-4}\ \text{lb/hr.}$$

0.0 [PLANT Phelps Dodge Ajo Arizona
LOCATION [illegible]

0.1 [STACK DIAMETER (IN.) 25.5

0.2 [DUCT DIMENSIONS (IN.) x (IN.)

1.0

1.1 [DATE 7/26/76
TIME 3:26 pm
RUN 6

1.2 [OPERATORS Pace

1.3 [STATIC PRESSURE (IN. WG.) −0.6
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.771

EOF

1.4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1.5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	375	350	305.1
Initial	350	350	295.3
Liquid Collected	25	0	9.8
			Total, V_{lc}
			34.8

EOF

1.6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
3 [illegible] 30	297.825	1.28	99	99	0.12	251
3 [illegible] 30	300.575	1.28	99	99	0.12	251
3 [illegible] 00	305.75	1.28	100	100	0.12	250
4 01	312.12	1.28	102	101	0.12	250
4 [illegible] 30	319.115	1.28	103	102	0.12	250
4 15 [illegible]	321.069	1.28				

Total, V_m	Average	Avg., T_m
[illegible]	[illegible]	[illegible]

EOF
EOF

PLANT Phelps Dodge, Ajo, Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 26.4
DUCT DIMENSIONS (IN.) x (IN.)

2.1 DATE 7/26/76
TIME 3:36 pm
RUN 2

2.2 OPERATOR(S) [illegible]

2.3 STATIC PRESSURE (IN. WG.) -0.2
AMBIENT PRESSURE (IN. HG.) 28.79
TYPE S PITOT COEFFICIENT 0.[illegible]

STACK GAS MOLECULAR WEIGHT

Stack Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
3:36:52	3.02	0.12	[illegible]
3:43:50	3.18	0.13	[illegible]
3:53:45	3.02	0.12	[illegible]
4:02:45	3.02	0.12	[illegible]
4:13	2.84	0.11	[illegible]

2.5

EOF

CO_2 (% by vol.)	O_2 (% by vol.)	CO (% by vol.)
1.6	16.9	0
1.7	16.9	0
1.7	16.8	0.1
Average	Average	Average
1.67	16.87	

2.6

EOF
EOF

PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 25 ft
DUCT DIMENSIONS (IN.) X (IN.)

4.01 DATE 7/26/76
TIME 2:56 pm
RUN 6

4.02 OPERATORS S. Lawley

4.03 STATIC PRESSURE (IN. WG.) − 0.6
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.751

STACK PRESSURE (IN. HG.) 28.15
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05 METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A 1	2:56	210	245		245	96	96	0.01	0.3	384.136	4
A 2		236	246		253	96	96	0.025	0.6	384.695	5
A 3		245	248		251	96	96	0.045	1.2	385.450	7
A 4	3:01	243	248		249	96	96	0.050	1.3	386.400	7
A 5		244	246		250	96	96	0.075	1.9	387.530	9
A 6		243	247		251	96	96	0.070	1.8	388.810	9
A 7	3:06	242	247		252	97	96	0.055	1.4	390.140	8
A 8		238	247		250	97	96	0.060	1.5	391.360	8
A 9		240	247		250	97	96	0.060	1.5	392.550	8
A 10	3:11	244	248		252	98	97	0.060	1.5	393.760	8
A 11		243	248		251	98	97	0.065	1.7	394.970	8
A 12		241	249		250	99	97	0.075	1.9	396.220	9
	3:16									397.555	
		Average				Average —	Average		Average	Total 15.41	
						Average —					

EOF

Vm
1.002

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 25.8
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/26/76
TIME 3:27 pm
RUN 6

4,02 OPERATORS Stanley

4,03
STATIC PRESSURE (IN.WG.) − 0.6
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.752

4,07
STACK PRESSURE (IN.HG.) 28.15
MOLECULAR WEIGHT (LB/LB-MOLE)
S_{wo}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4, 08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-1	3:27	97	232		171	96	97	0.01	0.3	397.644	4
B-2		21.	281		205	95	96	0.035	0.9	398.[illegible]	6
B-3		241	281		251	95	96	0.045	1.7	399.040	8
B-4	3:32	244	264		276	95	96	0.080	2.1	400.230	10
B-5		244	254		283	95	96	0.085	2.2	401.620	10
B-6		245	251		277	95	96	0.085	2.2	403.070	10
B-7	3:37	245	250		269	94	96	0.090	2.3	404.520	10
B-8		247	249		255	94	95	0.080	2.1	405.950	10
B-9		247	249		246	94	95	0.085	2.2	407.410	10
B-10	3:42	248	248		247	94	95	0.085	2.2	408.840	10
B-11		249	249		253	94	95	0.070	1.8	410.300	9
B-12		252	249		253	94	95	0.075	1.9	411.700	9
	3:47									413.031	
		Average				Average	Average		Average	Total	
						Average					

EOF

PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) x (IN.)

4.01
DATE 7/26/76
TIME 3:58 pm
RUN 6

4.02 OPERATORS Stanley

4.03
STATIC PRESSURE (IN. WG.) -0.6
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.751

STACK PRESSURE (IN. HG.) 28.15
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp		Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
						Inlet (°F)	Outlet (°F)				
C-1	3:58	246	237		184	94	95	0.01	0.3	413.140	4
C-2		245	244		223	94	95	0.02	0.6	413.670	5
C-3		246	242		262	95	95	0.02	0.6	414.390	5
C-4	4:03	247	248		274	95	95	0.02	0.6	415.150	6
C-5		246	246		271	96	95	0.035	0.9	415.920	6
C-6		246	249		262	96	95	0.030	0.8	416.820	6
C-7	4:08	247	248		254	96	95	0.030	0.8	417.730	6
C-8		252	248		241	97	95	0.020	0.6	418.620	5
C-9		255	246		234	97	96	0.015	0.4	419.480	5
C-10	4:13	252	247		244	97	96	0.035	0.9	420.090	6
C-11		248	248		256	98	96	0.025	0.6	420.960	5
C-12		249	248		255	98	97	0.030	0.8	421.850	6
	4:18									422.531	
		Average				Average	Average		Average	Total	
		[illegible]				95.833	95.[illegible]		1.284	9.39	
						Average	95.806				

EOF

+460
= [illegible]
+460
= 555.806
$(\sqrt{\Delta P})_{avg}$ = .2134
15.414 + 15.357 + 9.39
= 38.149
$V_{m_{std}}$ 38.123

RUN 6 7/26/96
AJO, ARIZONA
MAIN STACK

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\, H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (34.8)$$

$$= 1.65\ \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (26.58)\ \left(\frac{28.19 + \frac{1.28}{13.6}}{70.4 + 460}\right)$$

$$= 23.758\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{1.65}{1.65 + 23.758}$$

$$= .0649$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (1.669) + 0.32\ (16.869) + 0.28\ (81.466 + 0) + 0.64\ (0)$$

$= 28.944$ lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.944\ (1-.0649) + 18\ (.0649)$$

$= 28.2313$ lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \ X\ .751\ \ X\ (.2134) \sqrt{\frac{239.389 + 460}{(28.15)(28.2313)}}$$

$= 12.8515$ ft/sec

$$Q_s = 3600\,(1 - B_{wo})\,V_{s,avg}\,A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\,(1 - .0649)\,(12.851)(319.115)\left(\frac{530}{644.389}\right)\left(\frac{28.15}{29.92}\right)$$

$= 10,768,539$ scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

~~$= 0.0474\,V_{1c}$~~

~~$= 0.0474$~~

$=$ ft³

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,(28.121)\left(\frac{28.19 + \frac{1.229}{13.6}}{45.778 + 460}\right)$$

$= 34.357$ ft³

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 0 sec	1st reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{730.33}{34.357} (2.205 \times 10^{-6})$	$\frac{733.33}{34.357} (2.205 \times 10^{-6})$	$\frac{1021.53}{34.357} (2.205 \times 10^{-6})$
$= 4.6872 \times 10^{-5}$ lb/ft³	$= 4.7064 \times 10^{-5}$	$= 6.5561 \times 10^{-5}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (10,768,537)(4.6872 \times 10^{-5})$	$(10,768,537)(4.7064 \times 10^{-5})$	$(10,768,537)(6.5561 \times 10^{-5})$
= 504.7417 lb/hr	= 506.8151 lb/hr.	= 705.9943 lb/hr.

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{0.00267\ V_{1c} + \frac{V_m}{T_m}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right\}}{\theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\overset{699.384}{\quad})\left\{0.00267\ (34.8) + \frac{38.121}{555.406}\left(28.19 + \frac{1.281}{13.6}\right)\right\}}{(60)\cdot(14.18)(28.15)(1.0434 \times 10^{-3})}$$

$$= 94.7851$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(27.25 - .05)(.0101)\left(\frac{250}{25}\right)}{34.357}$$

$$= 8.7397 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (10{,}768{,}537)(8.7397 \times 10^{-6})$$

$$= 94.0944\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(1.30 - .05)(.1092)\left(\frac{495}{25}\right)}{34.357}$$

$$= 5.5459 \times 10^{-6} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (10{,}768{,}537)(5.5459 \times 10^{-6})$$

$$= 59.7212 \text{ lb/hr.}$$

0,0 [PLANT Phelps - Dodge, Ajo Arizona
LOCATION Mainstack

0,1 [STACK DIAMETER (IN.) 253

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/27/76
TIME 8:06 am
RUN 7

1,2 [OPERATORS Rice

1,3 [STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.20
TYPE S PITOT COEFFICIENT 0.771

1OF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	458	275	299.1
Initial	350	350	290.0
Liquid Collected	108	-75	9.1
			Total, $V_{\ell c}$
			42.1

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
8:06	321.209	1.07	83	83	0.10	249
	325.21	1.07	84	84	0.10	248
8:19:52	334.649					
8:38:30	334.649	1.07	85	84	0.10	248
8:47:30	340.550	1.12	86	84	0.11	248
8:53:30	344.475	1.28	87	85	0.12	252
9:02:30	350.915	1.39	88	86	0.13	248
9:04:30	352.320					

Total, V_m	Average	Avg., T_m
31.111	1.169	84.919 + 460

EOF
EOF

= 544.919

1.025 30.352

No Punch
PLANT Phelps-Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) x (IN.)

2,1 DATE 7/27/76
TIME 8:06 am
RUN 7

2,2 OPERATORS Rice

2,3 STATIC PRESSURE (IN. HG.)
AMBIENT PRESSURE (IN. HG.) 28.20
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
8:06	2.75	0.10	249
	2.75	0.10	248
8:39:45	2.75	0.10	247
8:48:00	3.02	0.12	249
8:54:00	2.89	0.11	252
9.03:00	3.02	0.12	248

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
1.6	17.3	0
1.6	17.4	0
1.6	17.3	0
Average	Average	Average
1.6	17.333	0

EOF
EOF

No Punch
PLANT *Phelps - Dodge, Ajo Arizona*
LOCATION *Main stack*
STACK DIAMETER (IN.) *253*
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE *7/27/76*
TIME *8:05 am*
RUN *7*

4.02 OPERATORS *Stanley*

4.03
STATIC PRESSURE (IN.WG.) ~~28.7~~ *-0.5*
AMBIENT PRESSURE (IN.HG.) *28.20*
TYPE S PITOT COEFFICIENT *0.751*

4.07
STACK PRESSURE (IN.HG.) *28.16*
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER *0039*
ORIFICE METER COEFFICIENT *0.698*
PROBE LENGTH (FT.) *10*
NOZZLE DIAMETER (IN.) *0.4375*

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
C-1	8:05	236	246		251	98	95	0.030	0.7	431.286	5
C-2		241	246		249	98	96	0.016	0.4	432.070	5
C-3		245	246		250	98	96	0.013	0.4	432.840	5
C-4	8:10	247	247		250	99	97	0.016	0.4	433.600	5
C-5		247	245		250	99	98	0.022	0.6	434.210	5
C-6		248	245		249	99	98	0.038	1.0	434.970	6
C-7	8:15	248	246		248	99	99	0.016	0.4	435.850	5
C-8		246	245		249	100	99	0.019	0.5	436.560	5
C-9		245	246		251	101	100	0.011	0.3	437.250	4
C-10	8:20	248	247		252	102	101	0.016	0.5	437.870	5
C-11		248	249		252	102	102	0.041	1.1	438.520	6
C-12		246	247		250	101	101	0.032	1.6	439.430	
	8:25									440.322	
		Average				Average	Average		Average	Total	
						Average					

EOF

Vm
1.002

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/27/76
TIME 8:45 am
RUN 7

4,02 OPERATORS Stanley

4,03
STATIC PRESSURE (IN.WG.) -0.5
AMBIENT PRESSURE (IN.HG.) 28.20
TYPE S PITOT COEFFICIENT 0.751

4,07
STACK PRESSURE (IN.HG.) 28.16
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B 1	8:45	155	238		128	95	97	0.014	0.4	440.414	5
B 2		205	249		171	94	97	0.024	0.6	441.050	5
B 3		247	249		208	93	97	0.030	0.8	441.860	5
B 4	8:50	252	251		248	92	96	0.033	0.9	442.700	6
B-5		253	251		263	92	95	0.038	1.0	443.630	6
B 6		257	251		260	91	95	0.047	1.2	444.620	7
B 7	8:55	255	251		252	91	94	0.055	1.4	445.670	7
B 8		254	250		246	91	93	0.038	1.0	446.800	7
B-9		253	251		247	91	93	0.038	1.0	447.870	6
B-10	9:00	253	251		249	91	92	0.044	1.1	448.870	7
B-11		253	251		250	91	92	0.049	1.3	449.910	7
B-12		213	249		248	91	92	0.041	1.1	450.980	7
										452.037	
	9:05										
		Average				Average —	Average —		Average —	Total 11.623	
						Average —					

EOF

No Punch
PLANT Phelps-Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/27/76
TIME 9:27 am
RUN 7

4.02 OPERATORS Stanley

4.03
STATIC PRESSURE (IN.WG.) - 0.5
AMBIENT PRESSURE (IN.HG.) 28.20
TYPE S PITOT COEFFICIENT 0.751

4.07
STACK PRESSURE (IN.HG.) 28.16
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	9:27	238	246		269	86	88	0.019	1.0	452.131	6
A-2		245	246		272	86	88	0.011	0.3	453.110	4
A-3		249	248		264	86	87	0.011	0.3	453.800	4
A-4	9:32	253	248		249	86	88	0.022	0.6	454.340	5
A-5		252	248		245	86	87	0.013	0.4	455.100	5
A-6		253	247		247	87	87	0.024	0.6	455.710	5
A-7	9:37	253	245		252	87	88	0.019	1.0	456.550	6
A-8		252	247		252	87	87	0.013	0.4	457.450	5
A-9		252	248		252	87	87	0.011	0.3	458.210	4
A-10	9:42	252	247		252	88	87	0.032	0.6	458.770	5
A-11		252	248		249	87	88	0.037	0.7	459.450	6
A-12		252	249		249	87	87	0.019	1.0	460.260	6
	9:47									461.200	
		Average 249.889				Average 92.922	Average 95.444		Average .714	Total [illegible]	
						Average [illegible]					

EOF

+460

709.389

9.036 + 11.623 + 9.069
29.728

$\frac{V_m}{1.002}$ 29.669

AJO, ARIZONA
MAIN STACK

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\, H_2O}{M_{H_2O}}\right) \left(\frac{R\, T_{std}}{P_{std}}\right)$$

$$= 0.0474\, V_{1c}$$

$$= 0.0474\ (42.1)$$

$$= 1.996\ \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (30.352) \left(\frac{28.20 + \frac{1.167}{13.6}}{84.917 + 460}\right)$$

$$= 27.903\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{1.996}{1.996 + 27.903}$$

$$= .06676$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (1.6) + 0.32\ (17.333) + 0.28\ (81.067 + 0) + 0.64\ (0)$$

$= 28.949$ lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.949\ (1-.06676) + 18\ (.06676)$$

$= 28.218$ lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48\ X\ .751\ X\ (.1556) \sqrt{\frac{704.384}{(28.16)\ (28.218)}}$$

$= 9.405$ ft/sec

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1 - .06676)\ (9.405)(249.115) \left(\frac{530}{704.384}\right)\left(\frac{28.16}{29.92}\right)$$

$$= 7{,}811{,}916 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{lc} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{lc}$$

$$= 0.0474$$

$$= \quad \text{ft}^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (29.664) \left(\frac{28.20 + \frac{.719}{13.6}}{553.083}\right)$$

$$= 26.841\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 0 sec	1st [illegible]	[illegible]
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{519.92}{26.341} (2.205 \times 10^{-6})$	$\frac{527.12}{26.441} (2.205 \times 10^{-6})$	$\frac{814.27}{26.441} (2.205 \times 10^{-6})$
$= 4.2712 \times 10^{-5}$ lb/ft³	$= 4.3303 \times 10^{-5}$	$= 6.64[illegible] \times 10^{-5}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (7811.916)(4.2712 \times 10^{-5})$	$(7811.916)(4.3303 \times 10^{-5})$	$(7,811.916)(6.64[illegible] \times 10^{-5})$
$= 333.6599$ lb/hr	$= 338.2805$ lb/hr	$= 526.1239$ lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\ \overset{704.389}{\quad}\ ) \left\{ 0.00267\ (42.1) + \frac{29.669}{553.083} \left(28.20 + \frac{.719}{13.6} \right) \right\}}{(60)\ (9.405)(28.16)(1.0439 \times 10^{-3})}$$

$$= 1.1524 \times 10^{2}$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(1.95 - .05)(.01331)\left(\frac{270}{5}\right)}{26.841}$$

$$= 5.4948 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (2,811,916)\ (5.4948 \times 10^{-6})$$

$$= 13.3009\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(17.70 - .05)(.1092)\left(\frac{535}{5}\right)}{26.841}$$

$$= 5.4168 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (7,811,916)(5.4168 \times 10^{-4})$$

$$= 4.2316 \times 10^{3} \text{ lb/hr.}$$

0,0 [PLANT Philps - Dodge, Ajo Arizona
LOCATION Mainstack

0,1 [STACK DIAMETER (IN.) 253

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/28/76
TIME 11:57 am
RUN 8

1,2 [OPERATORS Rice

1,3 [STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.771

1OF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	410	330	309.8
Initial	350	350	298.9
Liquid Collected	60	- 20	10.9
			Total, V_{lc}
			50.9

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
11:57	352.458	0.54	95	94	0.5	374
12:06:30	357.21	0.43	95	95	0.4	371
12:17	360.068	0.54	98	96	0.5	373
12:27	365.975	0.54	98	97	0.5	380
12:37	370.948	0.54	98	98	0.5	379
12:47	375.892	0.54	99	98	0.5	377
12:55	379.845	0.54	100	98	0.5	382
1:00	382.390	0.54	100	99	0.5	379
1:10	387.398					

Total, V_m	Average	Avg., T_m
34.94	.526	97.375 + 460°

EOF
EOF

= 557.375

$\frac{V_m}{1.025} = 34.087$

No Punch
PLANT Phelps - Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 25.1
DUCT DIMENSIONS (IN.) x (IN.)

2,1
DATE 7/28/76
TIME 11:57 am
RUN 8

2,2
OPERATORS Rice

2,3
STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2,5 A

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
11:57:30	3	0.05	374
12:07	3	0.05	372
12:13:30	3	0.05	373
12:27:30	3	0.05	381
12:37:30	3	0.05	374
12:47:15	3	0.05	377

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
2.9	14.4	0
2.9	14.5	0
2.9	14.4	0
Average	Average	Average
2.90	14.433	0

EOF
EOF

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 25.3
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/28/76
TIME 11:16 am
RUN 8

4.02
OPERATORS Stanley

4.03
STATIC PRESSURE (IN.WG.) −0.5
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.751

4.07
STACK PRESSURE (IN.HG.) 28.15
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp		Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
						Inlet (°F)	Outlet (°F)				
A-1	11:16	259	250		255	89	88	0.033	0.9	469.491	5
A-2		316	248		253	89	88	0.024	0.6	470.41	5
A-3		345	250		250	89	89	0.016	0.4	471.25	5
A-4	11:21	355	249		253	89	89	0.011	0.3	471.95	4
A-5		360	250		254	90	89	0.005	0.1	472.54	4
A-6		361	248		253	90	89	0.011	0.3	472.98	4
A-7	11:26	363	250		253	90	89	0.011	0.3	473.51	4
A-8		363	250		253	90	89	0.013	0.4	474.09	5
A-9		364	249		253	90	89	0.008	0.2	474.70	5
A-10	11:31	365	249		254	90	89	0.011	0.3	475.23	5
A-11		365	250		254	91	90	0.008	0.2	475.77	4
A-12	11:36	366	249		253	91	90	0.013	0.4	476.28	4
										476.86	
		Average				Average	Average		Average	Total	
						–	–		–	7.369	
						Average –					

EOF

V_m
1.002

No Punch
PLANT Phelps-Dodge, Ajo Arizona
LOCATION Moinstack
STACK DIAMETER (IN.) 25.3
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/28/76
TIME 11.55 am
RUN 8

4,02 OPERATORS Stanley

4,03
STATIC PRESSURE (IN.WG.) – 0.5
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT 0.751

STACK PRESSURE (IN.HG.)
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-1	11:55	154	248		280	91	90	0.019	0.5	476.981	5
B-2		216	247		286	91	90	0.011	0.3	477.70	4
B-3		306	248		281	92	91	0.008	0.2	478.31	4
B-4	12:00	352	246		271	91	90	0.005	0.1	478.82	4
B-5		361	246		262	92	91	0.005	0.1	479.22	4
B-6		366	248		247	92	91	0.011	0.3	479.60	4
B-7	12:05	367	248		248	92	91	0.008	0.2	480.07	4
B-8		370	246		253	92	91	0.008	0.2	480.55	4
B-9		370	248		256	92	91	0.005	0.1	481.10	4
B-10	12:10	371	247		252	92	91	0.008	0.2	481.51	4
B-11		371	246		252	93	91	0.011	0.3	481.94	4
B-12		371	246		253	93	91	0.013	0.4	482.51	5
	12:15									483.14	
		Average				Average Average	Average		Average	Total	

EOF

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 233
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/28/76
TIME 12:31 am
RUN 8

4,02 OPERATORS Stanley

4,03
STATIC PRESSURE (IN.WG.) -0.5
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT 0.751

4,07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
C-1	12:31	361	247		361	96	95	0.13	3.3	483.257	10
C-2		365	247		281	97	95	0.12	3.2	484.79	10
C-3		369	247		280	97	95	0.11	3.0	486.52	10
C-4	12:36	372	250		269	98	95	0.099	2.6	488.21	9
C-5		375	250		257	100	97	0.094 0.088	2.4	489.81	9
C-6		372	249		245	100	96	0.09	2.3	491.34	8
C-7	12:41	374	248		245	100	96	0.088	2.4	492.83	9
C-8		376	249		250	100	96	0.077	2.3	494.32	8
C-9		376	249		252	101	97	0.077	2.0	495.78	8
C-10	12:46	377	250		251	102	98	0.088	2.0	497.19	8
C-11		377	249		251	102	98	0.088	2.3	498.58	8
C-12		377	251		252	104	100		2.3	500.02	8
	12:51									501.459	
		Average [illegible]				Average [illegible]	Average 92.083		Average 1.039	Total 18.202	
						Average 92.958					

EOF

460
810.998

460
= 552.958

(IXT)..
.972

9.569 + 6.159 + 14.502
= 30.73
$\frac{V_a}{1.002}$ = 30.667

[illegible]
[illegible]
MAIN STACK

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (50.9)$$

$$= 2.4129\ ft^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (34.087)\left(\frac{28.19 + \frac{.526}{13.6}}{[illegible]}\right)$$

$$= 30.574\ ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{2.4129}{2.4129 + 30.574}$$

$$= .07314$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (2.90) + 0.32\ (14.40) + 0.28\ (82.69 + 0) + 0.64\ (0)$$

$= 29.04$ lb/lb-mole

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 29.04\ (1-.0734) + 18\ (.0734)$$

$= 28.232$ lb/lb-mole

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \times .751 \times (.192) \sqrt{\frac{550.918 + 460}{(28.15)(28.232)}}$$

$= 11.15$ ft/sec

$$Q_s = 3600\,(1 - B_{wo})\,V_{s,avg}\,A\left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\,(1 - .07314)\,(\text{[illegible]})\,(349.115)\left(\frac{530}{\text{[illegible]}\;460}\right)\left(\frac{28.15}{29.92}\right)$$

$= 9,990,882$ scfh

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$= 0.0474\,V_{1c}$

$= 0.0474$

$=$ ft³

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,(31.667)\left(\frac{28.14 + \frac{\text{[illegible]}}{13.6}}{\text{[illegible]}}\right)$$

$= 28.668$ ft³

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. Concentration of Particulate Matter

at 0 sec	1st Reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{286.21}{28.668} (2.205 \times 10^{-6})$	$\frac{288.46}{28.668} (2.205 \times 10^{-6})$	$\frac{337.96}{28.668} (2.205 \times 10^{-6})$
$= 2.20[illegible] \times 10^{-5}$ lb/ft³	$= 2.2189 \times 10^{5}$	$= 2.5994 \times 10^{-5}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (7,990,382)(2.2018 \times 10^{-5})$	$(7,990,382)(2.2189 \times 10^{-5})$	$(7,990,382)(2.5994 \times 10^{-5})$
$= 17[illegible]$ lb/hr	$= 177.2814$ lb/hr	$= 207.7036$ lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(310.978) \left\{ 0.00267\ (50.9) + \frac{31.665}{552.958} \left(28.14 + \frac{1.034}{13.6} \right) \right\}}{(60)\ (11.153)(28.15)(1.0439 \times 10^{-3})}$$

$$= 1.2059 \times 10^2$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(.05 - .05)(.01331)\left(\frac{155}{5}\right)}{28.668}$$

$$= \quad 0 \quad \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (7,990,3.82)(0)$$

$$= \quad 0 \quad \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(N\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(13.85 - .05)(.1092)\left(\frac{510}{5}\right)}{28.668}$$

$$= 3.7800 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (7,990,382)(3.7800 \times 10^{-4})$$

$$= 3.0204 \times 10^{3} \text{ lb/hr.}$$

0,0 PLANT Phelps - Dodge, Ajo Arizona
LOCATION Main stack

0,1 STACK DIAMETER (IN.) 253

0,2 DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 DATE 7/28/76
TIME 9:20 pm
RUN 9

1,2 OPERATORS Rice

1,3 STATIC PRESSURE (IN. WG.) - 0.5
AMBIENT PRESSURE (IN. HG.) 28.16
TYPE S PITOT COEFFICIENT 0.771

1OF

1,4 WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	420	295	302.4
Initial	350	350	292.7
Liquid Collected	70	- 55	9.7
			Total, V_{lc}
			24.7

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
9:20	387.542	0.43	97	98	0.04	358
9:30	392.415	0.54	95	97	0.05	365
9:35 :30	395.140	0.43	95	97	0.04	366
9:51	401.810	0.54	95	96	0.05	369
10:00	406.120	0.43	95	96	0.04	373
10:11	411.267					
	Total, V_m	Average	Avg., T_m			
	23725	0.474	96			

EOF
EOF

V_m P_{STD}

0,0 [PLANT *Phelps - Dodge, Ajo Arizona*
LOCATION *Mainstack*

0,1 [STACK DIAMETER (IN.) *253*

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE *7/28/76*
TIME *7:20 pm*
RUN *9*

1,2 [OPERATORS *Rice*

1,3 [STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) *28.19*
TYPE S PITOT COEFFICIENT *0.771*

1OF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	420	295	302.4
Initial	350	350	292.7
Liquid Collected	70	-55	9.7
			Total, $V_{\ell c}$
			24.7

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
7:20	387.542	0.43	97	98	0.04	358
7:30	392.415	0.54	95	97	0.05	365
7:3[illegible]:30	395.140	0.43	95	97	0.04	366
7:51	401.810	0.54	95	96	0.05	369
8:00	406.12	0.43	95	96	0.04	373
8:11:10	411.267					

Total, V_m	Average	Avg., T_m

EOF
EOF

No Punch
PLANT Phelps-Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) x (IN.)

2,1
DATE 7/28/76
TIME 9:20 pm
RUN 9

2,2 OPERATORS Rice

2,3
STATIC PRESSURE (IN. WG.) - 0.5
AMBIENT PRESSURE (IN. HG.) 28.16
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
9:20:30	3	.05	358
9:30:30	3	.04	365
9:36	3	.04	366
9:51:30	3	.05	369
10:00:25	3	.04	373

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
3.0	13.4	0
3.0	13.4	0
3.0	13.4	0
Average	Average	Average

EOF
EOF

No Punch
PLANT Phelps-Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) x (IN.)

2,1 DATE 7/28/76
TIME 7:20 pm
RUN 4

2,2 OPERATORS Rice

2,3 STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
7:20:30	3	0.05	358
7:30:30	3	0.04	365
7:36:	3	0.04	366
7:51:30	3	0.05	369
8:00:25	3	0.04	373

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
3.0	13.4	0
3.0	13.4	0
3.0	13.4	0
Average	Average	Average

EOF
EOF

No Punch

PLANT Phelps-Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 25'3
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/28/76
TIME 8:41 pm
RUN 9

4.02
OPERATORS Stanley

4.03
STATIC PRESSURE (IN.WG.) − 0.5
AMBIENT PRESSURE (IN.HG.) 28.16
TYPE S PITOT COEFFICIENT 0.787

4.07
STACK PRESSURE (IN.HG.) 28.12
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	8:41	344	249		264	84	84	0.0692	1.8	539.140	9
A-2		352	250		277	84	84	0.0636	1.6	540.430	9
A-3		364	250		273	85	84	0.0470	1.2	541.710	8
A-4	8:46	369	250		262	85	84	0.0498	1.3	542.860	8
A-5		371	250		251	85	84	0.0221	0.6	543.980	8
A-6		372	251		247	85	84	0.0249	0.6	545.100	6
A-7	8:51	372	251		244	85	84	0.0249	0.6	545.960	6
A-8		372	249		246	85	84	0.0221	0.6	546.750	5
A-9		372	250		252	86	85	0.0193	0.5	547.550	5
A-10	8:56	373	251		252	86	85	0.0221	0.6	548.270	5
A-11		371	251		250	86	86	0.0138	0.4	549.030	5
A-12		372	253		249	86	85	0.0221	0.6	549.700	5
	9:01									550.416	
		Average				Average Average	Average		Average	Total	

EOF

No Punch
PLANT Phelps - Dodge , Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/28/76
TIME 9:20 pm
RUN 9

4,02 OPERATORS Stanley
4,03
STATIC PRESSURE (IN.HG.) - 0.5
AMBIENT PRESSURE (IN.HG.) 28.16
TYPE S PITOT COEFFICIENT 0.787

4,07
STACK PRESSURE (IN.HG.) 28.12
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{WO}

4.05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4, 08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
C-1	9:20	313	244		250	84	86	0.1024	2.6	508.495	11
C-2		336	242		247	84	86	0.1051	2.7	510.030	11
C-3		345	243		247	84	86	0.1051	2.7	511.580	12
C-4	9:25	350	244		247	84	86	0.0941	2.4	513.140	11
C-5		353	244		249	84	85	0.1051	2.7	514.670	12
C-6		354	244		249	85	85	0.0913	2.4	516.230	12
C-7	9:30	356	244		250	84	85	0.0996	2.6	517.770	12
C-8		356	243		249	84	85	0.0858	2.2	519.320	11
C-9		358	244		248	84	85	0.1079	2.8	520.830	12
C-10	9:35	358	243		248	84	85	0.0996	2.6	522.360	12
C-11		358	245		249	84	85	0.1051	2.7	523.900	12
C-12		357	246		246	84	85	0.0885	2.3	525.450	11
	9:40									526.977	
		Average				Average	Average		Average	Total	
						Average					

EOF

P_{STD} 84.639
+460
= 544.639

$\sqrt{\Delta P}$ avg 0.3134

ΔH 1.481

V_M 41.693

$\frac{V_m}{1.002} = 41.6048$

354.167
+460
814.167

No Punch

PLANT Phelps-Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/28/76
TIME 9:59 pm
RUN 9

4,02 OPERATORS Stanley

4,03
STATIC PRESSURE (IN.HG.) −0.5
AMBIENT PRESSURE (IN.HG.) 28.16
TYPE S PITOT COEFFICIENT 0.787

4,07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER
ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. Hg.)
B-1	9:59	236	246		256	84	83	0.0775	2.0	527.046	10
B-2		292	249		262	84	83	0.0608	1.6	528.440	9
B-3		346	250		256	84	83	0.0498	1.3	529.750	7
B-4	10:04	357	249		249	84	83	0.0470	1.2	530.940	7
B-5		361	248		247	85	84	0.0442	1.1	532.040	7
B-6		363	247		252	85	84	0.0359	0.9	533.100	6
B-7	10:09	364	249		253	85	84	0.0332	0.9	534.030	6
B-8		366	249		254	85	84	0.0276	0.7	535.010	5
B-9		366	249		253	86	84	0.0221	0.6	535.880	5
B-10	10:14	367	250		252	86	85	0.0221	0.6	536.670	5
B-11		367	249		252	86	85	0.0276	0.7	537.440	5
B-12		367	250		250	86	85	0.0221	0.6	538.250	5
	10:19									539.031	
		Average				Average Average	Average		Average	Total	

EOF

[illegible] Mainstack Run 9

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\,V_{1c}$$

$$= 0.0474\,(24.7)$$

$$= 1.171\ \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,([illegible])\left(\frac{28.16 \cdot \frac{0.474}{13.6}}{[illegible]}\right)$$

$$= [illegible]\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{1.171}{1.171 - 20\ 783}$$

$$= 0\ 0533$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (3.0) + 0.32\ (13.4) + 0.28\ (83.6 + 0) + 0.64\ (0)$$

$$= 29.016 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 29.016\ (1-0.0533) + 18\ (0.0533)$$

$$= 28.429 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \times 0.787 \times [illegible] \sqrt{\frac{354.167 + 460}{28.12 \times 28.429}}$$

$$= 15.5 \text{ ft/sec}$$

$$Q_s = 3600\ (1 - B_{wo})\ V_{s,avg}\ A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\ (1-0.0533)\ (1.551)(349.165) \left(\frac{530}{\underset{+460}{354.167}}\right)\left(\frac{28.12}{29.92}\right)$$

$$= 1.129 \times 10^7 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho\ H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474$$

$$= 1.171 \quad ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ \frac{(41.693)}{1.002} \left(\frac{28.16 + \frac{1.481}{13.6}}{84.639+460}\right)$$

$$= 38.248 \quad ft^3$$

~~$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$~~

~~$= \frac{1.171}{1.171 + 38.248}$~~

~~$= 0.0297$~~

5. Concentration of Particulate Matter

at 0 sec	1st reading	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{1302.41}{38.248} (2.205 \times 10^{-6})$	$\frac{1305.21}{38.248} (2.205 \times 10^{-6})$	$\frac{1940.21}{38.248} (2.205 \times 10^{-6})$
$= 7.5084 \times 10^{-5}$ lb/ft³	$= 7.5245 \times 10^{-5}$	$= 1.1185 \times 10^{-4}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$		
$= (1.129 \times 10^{7})(7.5084 \times 10^{-5})$	$(1.129 \times 10^{7})(7.5245 \times 10^{-5})$	$(1.129 \times 10^{7})(1.1185 \times 10^{-4})$
$= 847.6987$ lb/hr	$= 849.5212$ lb/hr	$= 1262.8232$ lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6}\right)\right\}}{\theta V_s\ P_s\ A_n}$$

2.1647

$$= \frac{(1.667)(\text{[illegible]}) \left\{0.00267\ (24.7) + \frac{41.6098}{544.639} \left(28.16 + \frac{1.481}{13.6}\right)\right\}}{(60)\ (15.51)(28.12)(1.0439 \times 10^{-3})}$$

$= 110.6$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4})\ \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4})\ \frac{(.90 - .05)(.01331)\left(\frac{235}{10}\right)}{38.248}$$

$= 7.5072 \times 10^{-9}$ lb/ft^3

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$= (1.129 \times 10^{7})(7.5072 \times 10^{-9})$

$= 8.476$ lb/hr

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(19.45 - .05)(.1092)\left(\frac{615}{5}\right)}{38.248}$$

$$= 5.9889 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (1.129 \times 10^{6})(5.9889 \times 10^{-4})$$

$$= 6.7615 \times 10^{2} \text{ lb/hr.}$$

0,0 [PLANT Phelps - Dodge, Ajo Arizona
LOCATION Mainstack
0,1 [STACK DIAMETER (IN.) 253
0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/27/76
TIME 11:10 am
RUN 10
1,2 [OPERATORS Rice
1,3 [STATIC PRESSURE (IN. WG.) − 0.5
AMBIENT PRESSURE (IN. HG.) 28.16
TYPE S PITOT COEFFICIENT 0.771
1OF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	374	353	297.0
Initial	350	350	288.2
Liquid Collected	24	3	8.8
			Total, V_{lc}
			35.8

EOF

1,6

A

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
11:10:30	411.392	1.5	84	84	0.14	252
11:20 . 30	419.665	1.39	86	85	0.13	253
11:27 30	424.410	1.28	86	86	0.12	253
11.42:30	435.488	1.28	85	86	0.12	256
11:50 30	441.398	1.28	84	86	0.12	258
11:54 30	444.341					

Total, V_m	Average	Avg., T_m
32.949	1.346	85.2

EOF
EOF

[illegible] = 32.145
1.025

460
= 545.2

PLANT Phelps-Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) x (IN.)

2.1 DATE 7/29/76
TIME 11:10 am
RUN 10

2.2 OPERATORS Rice

2.3 STATIC PRESSURE (IN. WG.) -0.5
AMBIENT PRESSURE (IN. HG.) 28.16
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
11:11:30	3.26	0.14	252
11:20:54	3.02	0.12	253
11:27:54	3.02	0.12	253
11:42:48	3.02	0.12	255
11:50:48	3.02	0.12	258

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
1.5	17.1	0
1.5	17.2	0
1.5	17.2	0
Average	Average	Average
1.5	17.167	0

EOF
EOF

No Punch

PLANT Phelps Dodge, Ajo Arizona

LOCATION Mainstack

STACK DIAMETER (IN.) 253

DUCT DIMENSIONS (IN.) X (IN.)

4,01

DATE 7/29/76

TIME 10:20 am

RUN 10

4,02 OPERATORS Stanley, Sutton

4,03

STATIC PRESSURE (IN.HG.) −0.50

AMBIENT PRESSURE (IN.HG.) 28.16

TYPE S PITOT COEFFICIENT 0.787

STACK PRESSURE (IN.HG.) 28.12

4,07 MOLECULAR WEIGHT (LB/LB-MOLE)

B_{wo}

4,05

METER BOX NUMBER 0039

ORIFICE METER COEFFICIENT 0.698

PROBE LENGTH (FT.) 10

NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	10:20	153	248		247	84	85	.02	.52	558.096	6
A-2		154	248		246	84	85	.035	.903	558.795	8
A-3		188	248		245	84	84	.08	2.06	559.715	11
A-4	10:25	233	247		246	85	84	.08	2.06	561.00	12
A-4	10:26:40	252	249		248	85	84	.095	2.45	562.38	14
A-5	10:28:20	254	249		246	85	85	.1	2.58	563.68	15
A-6	10:30	254	248		246	85	85	.1	2.58	565.42	15
A-7		253	247		247	86	85	.1	2.58	566.95	15
A-8		253	249		247	86	85	.1	2.58	568.46	15.5
A-9	10:35	254	248		247	86	85	.11	2.84	569.95	17
A-10		254	249		247	87	85	.1	2.58	571.50	21
A-11		255	250		247	87	85	.085	2.2	572.96	24
A-12	10:40	255	250		247	87	85	.085	2.2	574.35	
	10:41:40									575.221	
		Average				Average	Average		Average	Total	
						—	—		—	17.125	
						Average —					

EOF

8 Punch

PLANT *Phelps-Dodge, Ajo Arizona*
LOCATION *Mainstack*
STACK DIAMETER (IN.) *253*
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE *7/29/76*
TIME *11:10 am*
RUN *10*

4,02 OPERATORS *Sutton*

4,03
STATIC PRESSURE (IN.WG.) *- 0.50*
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT *0.787*

4,07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4,05
METER BOX NUMBER *0039*
ORIFICE METER COEFFICIENT *0.698*
PROBE LENGTH (FT.) *10*
NOZZLE DIAMETER (IN.) *0.4375*

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-1	11:10	130	247	?	268	82	83	.015	.39	575.82	5
B-2		113	248		271	82	83	.01	.26	576.14	5
B-3		152	247		264	82	82	.01	.26	576.43	5
B-4	11:15	224	246		250	81	81	.05	1.3	577.50	9
B-5		251	247		235	81	82	.05	1.3	578.53	9
B 6		253	246		232	81	82	.06	1.55	579.615	10
B-7	11:20	252	246		240	81	82	.06	1.55	580.83	10
B-8		251	247		251	81	82	.03	.778	582.05	8
B-9		251	247		245	81	82	.05	1.3	583.09	8.5
B-10	11:25	251	247		242	80	82	.04	1.63	584.15	9
B-11		251	246		241	80	82	.04	1.63	585.16	8
B-12		250	247		253	80	81	.04	1.63	586.20	8
										587.24	
	11:30										
		Average				Average	Average		Average	Total	
						Average					

EOF

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/29/76
TIME 11:50
RUN 10

4.02 OPERATORS Sutton

4.03
STATIC PRESSURE (IN.WG.) - 0.50
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT 0.787

STACK PRESSURE (IN.HG.)
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
C-1	11:50	112	248		271	76	78	.01	.26	587.448	5
C-2		104	247		266	76	78	.015	.39	587.96	5
C-3		166	247		251	75	78	.03	.774	588.52	6.5
C-4	11:55	242	247		243	75	77	.02	.52	589.20	6
C-5		249	247		239	75	77	.035	.903	590.05	7
C-6		251	247		244	75	77	.04	1.03	590.94	7
C-7	12:00	251	248		253	75	76	.04	1.03	591.92	8
C-8		251	247		256	79	76	.05	1.3	592.73	8
C-9		250	247		253	75	76	.045	1.16	594.04	8.5
C-10	12:05	254	248		249	75	76	.03	.774	595.08	7
C-11		253	249		251	74	76	.03	.774	595.96	7
C-12		250	248		254	74	76	.04	1.03	596.82	8
	12:10									597.754	
		Average				Average	Average		Average	Total	
		[illegible]				[illegible]	[illegible]		1.347	10.306	
						Average	[illegible]				

EOF

4460
= 541.
ΔH [illegible]
= .218

17.625 + 11.440 + 10.306
= 39.371
$\frac{V_m}{1.002}$ = 39.292

RUN [illegible]
A30 , [illegible]
MAIN STACK

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\, H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (35.8)$$

$$= 1.697\ \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (32.145)\left(\frac{28.16 + \frac{1.346}{13.6}}{85.0 + 460}\right)$$

$$= 29.508\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{1.697}{1.697 + 29.508}$$

$$= .05438$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (1.5) + 0.32\ (17.167) + 0.28\ (81.333 + 0) + 0.64\ (0)$$

$$= 28.927 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.927\ (1-.05438) + 18\ (.05438)$$

$$= 28.338 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \text{ X } .784 \text{ X } (.218) \sqrt{\frac{223.957 + 460}{(28.12)(28.338)}}$$

$$= 13.686 \text{ ft/sec}$$

$$Q_s = 3600\,(1 - B_{wo})\,V_{s,avg}\,A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\,(1 - .05313)\,(5.58\text{[illegible]})(\text{[illegible]})\left(\frac{530}{\text{[illegible]}}\right)\left(\frac{28.12}{29.92}\right)$$

$$= 11{,}998{,}250 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\,V_{1c}$$

$$= 0.0474$$

$$= \quad \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,(\text{[illegible]})\left(\frac{28.16 + \frac{1.387}{13.6}}{\text{[illegible]}}\right)$$

$$= 30.348 \ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$=$$

$$=$$

5. Concentration of Particulate Matter

$$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$$

$$= \frac{727.78}{36.348} (2.205 \times 10^{-6}) \qquad \frac{734.06}{36.348} (2.205 \times 10^{-6}) \qquad \frac{1106.12}{36.348} (2.205 \times 10^{-6})$$

$$= 4.4150 \times 10^{-5} \text{ lb/ft}^3 \qquad = 4.4531 \times 10^{-5} \qquad = 6.7101 \times 10^{-5}$$

6. Emission Rate of Particulate Matter

$$ER = Q_s C_s$$

$$= (11,778,250)(4.4150 \times 10^{-5}) \qquad (11,778,250)(4.4531 \times 10^{-5}) \qquad (11,778,250)(6.7101 \times 10^{-5})$$

$$= 520.061 \text{ lb/hr} \qquad = 524.4939 \text{ lb/hr} \qquad = 790.3348 \text{ lb/hr}$$

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{lc} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(683.767) \left\{ 0.00267\ (35.8) + \frac{39.292}{541.} \left(28.16 + \frac{1.349}{13.6} \right) \right\}}{(61.69)\ (13.586)(28.12)(1.0454 \times 10^{-3})}$$

$$= 99.5647$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(N\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(1.65 - .05)(.01331)\left(\frac{225}{10}\right)}{36.348}$$

$$= 1.4239 \times 10^{-6}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (11,778,250)(1.4239 \times 10^{-6})$$

$$= 16.7687\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(12.85 - .05)(.1092)\left(\frac{555}{3}\right)}{36.348}$$

$$= 5.0155 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (11,778,250)(5.0155 \times 10^{-4})$$

$$= 5.9074 \times 10^{3} \text{ lb/hr.}$$

0,0 PLANT Phelps-Dodge, Ajo Arizona
LOCATION Mainstack

0,1 STACK DIAMETER (IN.) 253

0,2 DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 DATE 7/29/76
TIME 4:01 pm
RUN 11

1,2 OPERATORS Rice

1,3 STATIC PRESSURE (IN. HG.)
AMBIENT PRESSURE (IN. HG.) 28.16
TYPE S PITOT COEFFICIENT 0.771

1OF

1,4 WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	371	348	289.2
Initial	350	350	281.4
Liquid Collected	21	−2	7.8
			Total, V_{lc}
			26.8

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F) in	Gas Meter Temp (°F) out	Velocity Head (in. wg.)	Stack Gas Temp (°F)
4:01	445.171	1.50	84	84	0.14	258
4:06	449.245	1.07	84	84	0.10	257
4:12:30	453.780	1.39	84	85	0.13	255
4:17	457.220	1.39	85	85	0.13	256
4:27:30	465.252	1.39	86	85	0.13	253
4:36	471.815	1.50	86	86	0.14	251
4:42	476.562					

	Total, V_m	Average	Avg., T_m
$\frac{V_m}{1.025}$ =	30.625	1.37	84.8

EOF
EOF

No Punch
PLANT Phelps - Dodge, Ajo Arizona
LOCATION Mainstack
STACK DIAMETER (IN.) 353
DUCT DIMENSIONS (IN.) x (IN.)

2,1 DATE 7/29/76
TIME 4:01 am
RUN 11
2,2 OPERATORS Rice
2,3 STATIC PRESSURE (IN. WG.)
AMBIENT PRESSURE (IN. HG.) 28.16
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
4:02:18	3.02	0.12	257
4:06:30	3.26	0.14	256
4:13:	3.14	0.13	255
4:17:24	3.14	0.13	255
4:27:48	2.89	0.11	253
4:36:30	2.89	0.11	252

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
1.5	17.3	0
1.5	17.4	0
1.5	17.4	0
Average	Average	Average
1.5	17.4	0

EOF
EOF

No Punch

PLANT Phelps-Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/29/76
TIME 4:02 pm
RUN 11

4.02 OPERATORS Sutton

4.03
STATIC PRESSURE (IN.WG.) - 0.5
AMBIENT PRESSURE (IN.HG.) 28.16
TYPE S PITOT COEFFICIENT 0.787

STACK PRESSURE (IN.HG.) 28.12
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.06
METER BOX NUMBER 0038
ORIFICE METER COEFFICIENT 0.680
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
C-1	4:02	85	248		252	79	80	0.02	0.52	625.264	6
C-2		89	247		241	79	80	0.03	0.774	625 89	7
C-3		165	247		231	79	80	0.04	1.03	626.72	8
C-4	4:07	242	247		229	79	80	0.04	1.03	627.695	8
C-5		251	247		243	79	80	0.06	1.55	628.68	10.5
C-6		251	247		250	79	80	0.06	1.55	629.84	10.5
C-7	4:12	252	247		252	79	80	0.07	1.81	631.02	13
C-8		251	247		247	79	80	0.05	1.80	632.37	11
C-9		251	248		244	79	80	0.065	1.68	633.55	11
C-10	4:17	250	247		247	80	80	0.065	1.68	634.76	12
C-11		249	247		251	80	80	0.06	1.55	636.01	11.5
C-12		250	248		253	80	80	0.06	1.55	637.21	11.5
	4:22									638.404	
		Average 215.5				Average 79.3	Average 80	.224	Average 1.377	Total 13.114	
						Average 79.7					

EOF

$\frac{V_m}{100}$✓

No Punch
PLANT Phelps Dodge, Ajo Arizona
LOCATION Main Stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4,01
DATE 7/29/76
TIME 4:37 pm
RUN 11

4,02 OPERATORS Sutton

4,03
STATIC PRESSURE (IN.WG.) −0.5
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT 0.787

4,07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{WO}

4,05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
B-1	4:37	126	251	~~243~~	243	79	79	.01	.26	638.526	5
B-2		124	250		246	79	79	.01	.26	639.04	5
B-3		160	250		239	79	79	.01	.26	639.59	5
B-4	4:42	232	251		230	79	79	.01	.26	640.115	5
B-5		247	251		218	80	80	.03	.774	640.65	7
B-6		247	250		209	80	79	.03	.774	641.415	7
B-7	4:47	247	250		216	80	79	.04	1.03	642.22	9
B-8		249	252		240	80	77	.05	1.3	643.185	10
B-9		249	252		260	81	79	.035	.903	644.32	8
B-10	4:52	251	251		258	81	77	.04	1.03	645.31	8
B-11		252	253		251	81	80	.04	1.03	646.28	8
B-12		252	251		244	81	80	.04	1.03	647.27	8
	4:57									648.23	
		Average 220				Average 80 Average	Average 79 79.5	Average .183	Average .743	Total 9.625	

EOF

Vm
[illegible]

PLANT *Phelps-Dodge, Ajo Arizona*
LOCATION *Main stack*
STACK DIAMETER (IN.) *252*
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE *7/29/76*
TIME *5:15 pm*
RUN *11*

4.02 OPERATOR: *Sutton*

4.03
STATIC PRESSURE (IN.HG.) *-0.5*
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT *0.787*

4.07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.06
METER BOX NUMBER *0039*
ORIFICE METER COEFFICIENT *0.698*
PROBE LENGTH (FT.) *10*
NOZZLE DIAMETER (IN.) *0.4375*

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	5:15	181	253		264	82	81	.01	.26	648.36	5
A-2		182	252		283	82	81	.01	.26	648.84	5
A-3		201	253		280	82	81	.01	.26	649.35	5
A-4	5:20	245	252		267	83	82	.025	.25	649.865	7
A-5		255	250		254	83	83	.04	1.02	650.61	8
A-6		256	253		242	84	82	.04	1.03	651.57	8
A-7	5:25	255	251		240	84	82	.035	.903	652.35	8
A-8		255	251		245	84	82	.045	1.16	653.52	8
A-9		253	[illegible]		244	85	82	.045	1.16	654.55	7
A-10	5:30	253	252		248	85	83	.03	.774	655.565	8
A-11		253	253		245	85	83	.03	.774	656.485	7.5
A-12		254	254		246	85	83	.03	.774	657.33	7
	5:35									658.21	
		Average 224.1				Average 83.7	Average 82.1		Average .75	Total 9.72	
						Average 82.9					

EOF

avg = 224.1 + 460 = 684.1

avg = 80.7 + 460 = 540.7

avg .4577

342<

1. Stack Gas Moisture Content (Moisture Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\,V_{1c}$$

$$= 0.0474(26.8)$$

$$= 1.2703\ \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (30.625)\left(\frac{28.16 + \frac{1.37}{13.6}}{84.8 + 460}\right)$$

$$= 28.1346\ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{1.2703}{1.2703 + 28.1346}$$

$$= 0.0432$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (1.5) + 0.32\ (17.4) + 0.28\ (81.1 + 0) + 0.64\ (0)$$

$$= 28.936 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.936(1-.0432) + 18\ (.0432)$$

$$= 28.4636 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_p C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_{s,avg}}{P_s M_s}}$$

/

$$= 85.48 \text{ X } .787 \text{ X } .184 \sqrt{\frac{224.1 + 460}{(28.12)(28.4636)}}$$

$$= 11.4436 \text{ ft/sec}$$

$$Q_s = 3600\,(1 - B_{wo})\,V_{s,avg}\,A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$= 3600\,(1 - .0432)\,(11.4436)(349.115)\left(\frac{530}{224.1 + 460}\right)\left(\frac{28.12}{29.92}\right)$$

$$= 10{,}019{,}934 \quad \text{scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\,V_{1c}$$

$$= 0.0474$$

$$= \quad \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,(32.614)\left(\frac{28.16 + \frac{1.37}{13.6}}{84.8 + 460}\right)$$

$$= 24.9665 \ \text{ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

=

=

5. **Concentration of Particulate Matter**

at 0 sec	1st reading	Equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{697.06}{29.9665} (2.205 \times 10^{-6})$	$\frac{733.97}{29.9665} (2.205 \times 10^{-6})$	$\frac{966.67}{29.9665} (2.205 \times 10^{-6})$
$= 5.1291 \times 10^{-5}$ lb/ft³	$= 5.4007 \times 10^{-5}$	$= 7.1130 \times 10^{-5}$

6. **Emission Rate of Particulate Matter**

$ER = Q_s C_s$		
$= (10{,}019{,}934)(5.1291 \times 10^{-5})$	$(10{,}019{,}934)(5.4007 \times 10^{-5})$	$(10{,}019{,}934)(7.113 \times 10^{-5})$
$= 513.9343$ lb/hr	$= 541.1496$ lb/hr	= [illegible] lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\Theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\overset{684.133}{\quad}) \left\{ 0.00267\ (26.8) + \frac{32.619}{540.9} \left(28.16 + \frac{.9577}{13.6} \right) \right\}}{(60)\ (11.4436)(28.12)(1.0439 \times 10^{-3})}$$

$$= 1.0041 \times 10^{2}$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(.95 - .05)(.01331)\left(\frac{240}{10}\right)}{29.4665}$$

$$= 8.0589 \times 10^{-7}\ \mathrm{lb/ft^3}$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (10{,}019{,}934) \cdot (8.0589 \times 10^{-7})$$

$$= 8.07496\ \mathrm{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right)\left(\underline{N}\right)\left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(12.05 - .05)(.1192)\left(\frac{625}{5}\right)}{24.4655}$$

$$= 3.8536 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (10{,}019{,}934) \cdot (3.8536 \times 10^{-4})$$

$$= 3.8613 \times 10^{3} \text{ lb/hr.}$$

0,0 [PLANT Phelps Dodge, Ajo Arizona
LOCATION Mainstack

0,1 [STACK DIAMETER (IN.)

0,2 [DUCT DIMENSIONS (IN.) x (IN.)

1,0

1,1 [DATE 7/30/76
TIME 12:10 pm
RUN 12

1,2 [OPERATORS Steiner

1,3 [STATIC PRESSURE (IN. WG.) - 0.5
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.771

IOF

1,4 [WET BULB TEMP (°F)
DRY BULB TEMP (°F)
MOISTURE (% VOL.)
B_{wo}

STACK GAS MOISTURE (CONDENSATION)

1,5

	Impinger #1 Weight (gm)	Impinger #2 Weight (gm)	Silica Gel Weight (gm)
Final	446	340	282.4
Initial	350	350	271.1
Liquid Collected	96	-10	11.3
			Total, V_{lc}
			97.3

EOF

1,6

Clock Time	Dry Gas Meter (ft³)	Rotameter Reading (cfh)	Gas Meter Temp (°F)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
12:10	476.562	2.0	90 90	0.15	258
12:21	483.700	2.0	91 91	0.16	255
2 31	492.53	2.0	93 92	0.15	257
2.45	504.88	2.0	95 93	0.15	258
12:55	513.63	2.0	95 94	0.15	258
1:05	522.415	2.0	96 95	0.15	257

Total, V_m	Average	Avg., T_m
[illegible]	[illegible]	92.[illegible]

+460°

= 652.917

[illegible]

EOF
EOF

1 025

No Punch
PLANT Phelps-Dodge, Ajo Arizona
LOCATION Main Stack
STACK DIAMETER (IN.)
DUCT DIMENSIONS (IN.) x (IN.)

2,1
DATE 7/30/76
TIME 12:10 pm
RUN 12

2,2 OPERATORS Steiner

2,3
STATIC PRESSURE (IN. WG.) -0.5
AMBIENT PRESSURE (IN. HG.) 28.19
TYPE S PITOT COEFFICIENT 0.771

STACK GAS MOLECULAR WEIGHT

2,5

Clock Time	Rotameter Reading (cfh)	Velocity Head (in. wg.)	Stack Gas Temp (°F)
12:10	3	0.15	258
12:21	3	0.15	256
12:31	3	0.15	257
12:45	3	0.15	258
12:55	3	0.15	258
1:05	3	0.15	257

EOF

2,6

CO_2 (% by Vol.)	O_2 (% by Vol.)	CO (% by Vol.)
1.3	17.2	0
1.4	17.3	0
1.3	17.2	0
Average	Average	Average
1.333	17.233	

EOF
EOF

No Punch
PLANT Phelps - Dodge , Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/30/76
TIME 11:15 am
RUN 12

4.02 OPERATORS Sutton

4.03
STATIC PRESSURE (IN.WG.) – 0.5
AMBIENT PRESSURE (IN.HG.) 28.19
TYPE S PITOT COEFFICIENT 0.787

STACK PRESSURE (IN.HG.) 28.15
4.07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER 0039
ORIFICE METER COEFFICIENT 0.698
PROBE LENGTH (FT.) 10
NOZZLE DIAMETER (IN.) 0.4375

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
A-1	11:15	198	252		246	88	87	0.03	0.774	670.538	6.5
A-2		188	253		251	88	88	0.03	0.774	671.375	6.5
A-3		201	254		250	88	88	0.065	1.68	672.235	10
A-4	11:20	226	252		245	89	88	0.075	1.93	673.480	11
A-5		250	252		244	89	88	0.08	2.06	674.740	12
A-6		251	254		246	90	88	0.08	2.06	676.175	12
A-7	11:25	254	253		249	90	88	0.075	1.93	677.565	12
A-8		259	252		247	90	89	0.08	2.06	678.91	12.5
A-9		256	251		246	91	89	0.08	2.06	680.28	14
A-10	11:30	256	253		246	91	89	0.07	1.81	681.64	18
A-11		255	251		246	91	89	0.08	2.06	682.87	21
A-12		255	253		248	92	89	0.08	2.06	684.82	24.5
	11:35									685.573	
		Average				Average	Average		Average	Total	
		[illegible]				[illegible]	[illegible]		[illegible]	[illegible]	
						Average [illegible]					

EOF

1-092

No Punch

PLANT Phelps-Dodge, Ajo Arizona
LOCATION Main stack
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) x (IN.)

4,01 DATE 7/30/76
TIME 11:58 am
RUN 12

4,02 OPERATORS Sutton

STATIC PRESSURE (IN.HG.)
4,03 AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT

STACK PRESSURE (IN.HG.)
4,07 MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

METER BOX NUMBER
4,05 ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4,08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp		Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
						Inlet (°F)	Outlet (°F)				
B-1	11:58	179	252		288	89	89	0.01	0.26	685.710	5
B-2		145	251		285	90	89	0.05	1.3	686.125	7
B-3		140	252		279	90	89	0.05	1.3	686.99	7
B-4	12:03	190	251		267	90	89	0.05	1.3	688.035	8.5
B-5		249	252		251	90	89	0.07	1.81	689.185	11
B-6		256	250		240	90	89	0.09	2.32	690.399	13.5
B-7	12:08	258	252		232	90	89	0.08	2.06	691.77	13
B-8		254	251		236	90	89	0.07	1.81	693.19	12
B-9		253	250		267	90	89	0.09	2.32	694.565	13
B-10	12:13	253	256		266	90	89	0.09	2.32	695.965	14
B-11		252	251		266	90	89	0.075	1.81	697.42	14
B-12		252	250		253	90	89	0.08	2.06	698.62	15.5
	12:18									700.077	
		Average [illegible]				Average [illegible]	Average [illegible]		Average [illegible]	Total [illegible]	

EOF

No Punch

PLANT *Phelps Dodge, Ajo Arizona*
LOCATION *Main stack*
STACK DIAMETER (IN.) 253
DUCT DIMENSIONS (IN.) X (IN.)

4.01
DATE 7/30/76
TIME 12:45 pm
RUN 12

4.02 OPERATORS *Sutton*

4.03
STATIC PRESSURE (IN.HG.)
AMBIENT PRESSURE (IN.HG.)
TYPE S PITOT COEFFICIENT

4.07
STACK PRESSURE (IN.HG.)
MOLECULAR WEIGHT (LB/LB-MOLE)
B_{wo}

4.05
METER BOX NUMBER
ORIFICE METER COEFFICIENT
PROBE LENGTH (FT.)
NOZZLE DIAMETER (IN.)

PARTICULATE SAMPLING DATA

4.08

Sampling Point Number	Clock Time	Stack Gas Temp (°F)	Probe Temp (°F)	Impinger Outlet Temp (°F)	Oven Temp (°F)	Dry Gas Meter Temp Inlet (°F)	Dry Gas Meter Temp Outlet (°F)	Velocity Head (in. wg.)	Orifice Meter (in. wg.)	Gas Meter Volume (ft.³)	Pump Vacuum (in. hg.)
C-1	12:45	156	245		210	94	93	0.04	1.03	700.211	7
C-2		184	248		251	94	93	0.06	1.55	701.45	9.5
C-3		250	252		270	94	94	0.07	1.81	702.30	11
C-4	12:50	254	249		270	94	94	0.07	1.81	703.615	11
C-5		256	252		258	95	94	0.095	2.45	704.950	12
C-6		256	249		252	96	94	0.075	1.93	706.37	12
C-7	12:55	256	249		246	96	94	0.095	2.45	707.75	13
C-8		256	250		251	98	96	0.10	2.58	709.25	14.5
C-9		256	245		252	98	95	0.085	2.2	710.785	14
C-10	1:00	255	249		253	98	96	0.10	2.58	712.25	14
C-11		256	252		253	99	96	0.09	2.32	713.76	15
C-12		257	251		252	100	97	0.095	2.45	715.26	19
	1:05									716.715	
		Average				Average	Average		Average	Total	
		[illegible]				91.333	[illegible]		2.0[illegible]	16.504	
						Average	[illegible]				

EOF

233.833 + 460
693.833

91.333 + 460
551.333

[illegible] .2619

1.831

16.471

Total [illegible] 45.814

PHELPS-DODGE AJO ARIZ
RUN #12 MAIN-TH[illegible]

1. **Stack Gas Moisture Content** (Moisture Train Data)

$$V_{w,std} = V_{1c} \left(\frac{\rho H_2O}{M_{H_2O}}\right)\left(\frac{R\ T_{std}}{P_{std}}\right)$$

$$= 0.0474\ V_{1c}$$

$$= 0.0474\ (97.3)$$

$$= 4.6202\ ft^3$$

$$V_{m,std} = V_m \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\ (44.735) \left(\frac{22.19 + \frac{2}{13.6}}{(460 + 92.414)}\right)$$

$$= 40.003\ ft^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

$$= \frac{4.61202}{4.61202 + 40.003}$$

$$= .10200$$

2. Stack Gas Composition

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$+0.64\ (\%SO_2)$$

$$= 0.44\ (1.333) + 0.32\ (17.233) + 0.28\ (81.434 + 0) + 0.64\ (0)$$

$$= 28.9026 \text{ lb/lb-mole}$$

$$M_s = M_d\ (1-B_{wo}) + 18\ B_{wo}$$

$$= 28.9026\ (1-.102) + 18\ (.102)$$

$$= 27.791 \text{ lb/lb-mole}$$

3. Stack Gas Velocity and Flowrate

$$V_{s,avg} = K_pC_p\left(\sqrt{\Delta P}\right)_{avg}\sqrt{\frac{T_{s,avg}}{P_sM_s}}$$

$$= 85.48 \times .787 \times .26519\sqrt{\frac{(233.80 + 460°)}{(28.15)(27.791)}}$$

$$= 16.801 \text{ ft/sec}$$

$$Q_s = 3600\,(1 - B_{wo})\,V_{s,avg}\,A \left(\frac{T_{std}}{T_{s,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

$$A = \frac{\pi\,(253)^2}{(4)(144)}$$

$$= 3600\,(1 - .102)\,(16.801)(344.15)\left(\frac{530}{[illegible]}\right)\left(\frac{28.15}{29.92}\right)$$

$$= 1.3429 \times 10^7 \text{ scfh}$$

4. Stack Gas Moisture Content (Particulate Train Data)

$$V_{w,std} = V_{1c}\left(\frac{\rho\,H_2O}{M_{H_2O}}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$$= 0.0474\,V_{1c}$$

$$= 0.0474$$

$$= \quad \text{ft}^3$$

$$V_{m,std} = V_m\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right)$$

$$= 17.71\,(45.514)\left(\frac{28.19 + \frac{1.281}{13.6}}{(41.[illegible] + 460)}\right)$$

$$= 41.[illegible] \text{ ft}^3$$

$$B_{wo} = \frac{V_{w,std}}{V_{w,std} + V_{m,std}}$$

= [illegible]

= [illegible]

5. Concentration of Particulate Matter

at 0 sec	1st mixing	equilibrium
$C_s = \frac{M}{V_{m,std}} (2.205 \times 10^{-6})$		
$= \frac{816.88}{41.6838} (2.205 \times 10^{-6})$	$\frac{825.07}{41.6838} (2.205 \times 10^{-6})$	$\frac{1194.70}{41.6838} (2.205 \times 10^{-6})$
$= 4.3212 \times 10^{-5}$ lb/ft³	$= 4.3645 \times 10^{-5}$	$= 6.3196 \times 10^{-5}$

6. Emission Rate of Particulate Matter

$ER = Q_s C_s$

$= (1.3628 \times 10^{7})(4.3212 \times 10^{-5})$	$(1.3628 \times 10^{7})(4.3645 \times 10^{-5})$	$(1.3628 \times 10^{7})(6.3196 \times 10^{-5})$
= [illegible] lb/hr	= 594.7908 lb/hr	= 861.2560 lb/hr

7. Percent Isokinetic

$$I = \frac{1.667\ T_s \left\{ 0.00267\ V_{1c} + \frac{V_m}{T_m} \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right\}}{\theta V_s\ P_s\ A_n}$$

$$= \frac{(1.667)(\text{[illegible]}) \left\{ 0.00267\ (\text{[illegible]}) + \frac{\text{[illegible]}}{\text{[illegible]}} \left(\text{[illegible]} + \frac{\text{[illegible]}}{13.6} \right) \right\}}{(\text{[illegible]})\ (\text{[illegible]})(\text{[illegible]})(\text{[illegible]})}$$

$$= \text{[illegible]} \times 10^{2}$$

8. Concentration of Sulfur Trioxide/Acid Mist

$$C_{H_2SO_4} = (1.08 \times 10^{-4}) \frac{\left(V_t - V_{tb}\right) \left(N\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (1.08 \times 10^{-4}) \frac{(\text{[illegible]} - \text{[illegible]})(\text{[illegible]})\left(\frac{\text{[illegible]}}{\text{[illegible]}}\right)}{\text{[illegible]}}$$

$$= \text{[illegible]} \times 10^{-7}\ \text{lb/ft}^3$$

9. Emission Rate of Sulfur Trioxide/Acid Mist

$$ER = Q_s\ C_{H_2SO_4}$$

$$= (\text{[illegible]})(\text{[illegible]} \times 10^{-7})$$

$$= \text{[illegible]}\ \text{lb/hr}$$

10. Concentration of Sulfur Dioxide

$$C_{SO_2} = (7.05 \times 10^{-5}) \frac{\left(V_t - V_{tb}\right) \left(\underline{N}\right) \left(\frac{V_{soln}}{V_a}\right)}{V_{m,std}}$$

$$= (7.05 \times 10^{-5}) \frac{(17.90 - .05)(.1092)\left(\frac{405}{3}\right)}{41.6838}$$

$$= 4.4506 \times 10^{-4} \text{ lb/ft}^3$$

11. Emission Rate of Sulfur Dioxide

$$ER = Q_s C_{SO_2}$$

$$= (1.3[illegible] \times 10^{4})(4.0494 \times 10^{-4})$$

$$= 5.5165 \times 10^{[illegible]} \text{ lb/hr.}$$

APPENDIX C

PROCESS WEIGHT DATA

Copper Blow Test on B Shift of 7/20/76

1 Converter Gas Stream.

Copper Blow Test on B Shift of. 7/20/76

	Taps	Matte Tons	Flux Tons	Chip Tons	Copper Blow Min	Cu Tons.
Converter No 1	8	176	30	20	135	45
Converter No. 2						
Converter No 3.						

Total Weight Charged to Converter on shift of

	Matte in Conv.	Chips	Flux	Conct.	Total.
Converter No. 1	165	24	30	0	219
Converter No 2					
Converter No 3					

Total Input into Reverb Furnace. on shift of.

Natural Gas.	Air	Conct.	Conv Slag	P pt.	Lime	Dust.
173000/hr	1,820,000 CF/HR	177	173	8	13	6

DAILY CONVERTER

STAND 1 24-0-8/32 DATE 7-20-76

SHIFT A

Operation ______ Convertor Status [illegible] Tuyeres: Found 112 Left [illegible] Integrator Reading .10 3 6632-2 7 1

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
4	2½		10:55	11:55	2		
2	2	½	12:35	1:35	2		
2	3½		1:50	2:30	2		
	2		3:00				

Flux-Cans 3 Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT B

Operation ______ Converter Status ~~[illegible]~~ Tuyeres: Found ______ Left ______ Integrator Reading 6636-1

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				3:55	1¼		2
	Collar + ½-¾		4:10	6:25			
		½ dust					

Flux-Cans ______ Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT C

Operation ______ Converter Status Empty Tuyeres: Found 112 Left ______ Integrator Reading 6631-1

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
4	2		3:45	4:50		[illegible] #3	
	2		6:50				

Flux-Cans 1½ Copper-Reverts ______ Oxide Slag-ladle 1

Integrator Reading 6411-3

8

363<

DAILY CONVERTER

STAND 3

DATE 7-20-76 7/7/11

SHIFT A

Operation ______

Convertor Status: 1 Blowing

Tuyeres: Found 18

Left 18

Integrator Reading: ~~66~~98-5 89 11.0

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				9:10	1½		3
		Ch 15T ½	7:55	10:55			
[illegible]		B					

Flux-Cans ______ Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT B

Operation ______

Convertor Status: 2½ Taps

Tuyeres: Found 48

Left 48

Integrator Reading: 6681-9

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
2	2½		6:25	7:20	3		
2	2	Collar	8:30	9:20	2		
2	3		9:35	10:25	2		
2	3		11:00				
10½							

Flux-Cans 3½ Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT C

Operation ______

Convertor Status: 10½ Blowing

Tuyeres: Found 46

Left [illegible]

Integrator Reading: 6684-7

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				12:10	2		
	3		12:15	12:30	1		3
		Cu 12:35	12:35	3:35			
4	2	Sdust	5:30	6:00	1½	Transfer to #1	

Flux-Cans 1 Copper-Reverts ______ Oxide Slag-ladle 1

Integrator Reading: 6689-5

REVERBERATORY FURNACE OPERATION

DATE 7-20-76

A SHIFT			B SHIFT			C SHIFT			
BATH MEASUREMENTS			BATH MEASUREMENTS			BATH MEASUREMENTS			TOTALS
TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	
7:15	19	27-	3 15	21	27	11 15	21	27+	
9:00	21	27-	5 00	20	27	1 00	21	27	
11:00	20	27	7 00	21	27+	3 00	20	27	
1:00	19	27	9 00	20	27	5 00	20	27	

	A SHIFT	B SHIFT	C SHIFT	TOTALS
CANS CHARGED TO FURNACE	21	20	18	59
LADLES REVERB SLAG	8	9	8	25
LADLES MATTE	10½ ~~7½~~	8	8	26½
LADLES CONVERTER SLAG	8	9	7	24
REMARKS	REMARKS	REMARKS	REMARKS	
	40 GAL #2 Diesel fuel			
	+17 - 8 - 7 [illegible]	[illegible]	[illegible]	

FORMAN [illegible] FORMAN [illegible] FORMAN Reedy

Copper Blow Test on A Shift of 7/21/76

1 Converter Gas Stream.

Copper Blow Test on A Shift of. 7/21/76

	Taps	Matte Tons	Flux Tons	Chip Tons	Copper Blow Min	Cu Tons
Converter No 1	8	126	15	20	185	55
Converter No. 2						
Converter No 3.						

Total Weight Charged to Converter on A shift of 7/21

	Matte in Cu.	Chips	Flux	Conct.	Total.
Converter No. 1	165	25	15	3	208
Converter No 2					
Converter No 3					

Total Input into Reverb Furnace. on A shift of. 7/21

Natural Gas.	Air	Conct.	Conv Slag	P pt.	Lime	Dust.
172,000/h	1,520,000 CFH.	176	116	8	10	7

1 Converter Gas Stream.

Copper Blow Test on B shift of 7/21

	Taps	Matte Tons	Flux Tons	Chip Tons	Copper Blow Min	Cu Tons
Converter No. 1						
Converter No. 2						
Converter No 3.	8	126	30	28	100	35

Total Weight Charged to Converter on B shift of 7/21

	Matte from Rev.	Chips	Flux	Conct.	Total.
Converter No. 1					
Converter No 2					
Converter No 3	165	28	30	3	226

Total Input into Reverb Furnace. on B shift of 7/21

Natural Gas.	Air	Conct.	Conv Slag	Ppt.	Lime	Dust
172,000	182,000	160	145	8	13	6

STAND 1 15-06-31 DATE 7-21-76 ✓

SHIFT A

Operation ______ Convertor Status 8 Blowing

Tuyeres: Found 112
Left ______

Integrator Reading 640-3

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
		[illegible]	[illegible]	[illegible]	2½		2½
4	2		1:40	3:30	3		
2							
(6)							

Flux-Cans 3 Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT B

Operation CBO Converter Status 6-Taps

Tuyeres: Found 42
Left 42

Integrator Reading 0644-5

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	3½		7:15	7:35	2¼		
2	3½		8:30	9:30	2		
	1		9:40	10:00	1¾		
	½		10:15	10:25			
	Callax + ½		11:05				

Flux-Cans 2½ Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT C

Operation CBO Converter Status [illegible]

Tuyeres: Found 42
Left 42

Integrator Reading 6474

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
		[illegible]		7:[illegible]		[illegible] from # 3	2
2	2½		[illegible]:45	[illegible]	2½		
		[illegible]	3:45	3:[illegible]			1¾
[illegible]							

Flux-Cans 1 Copper-Reverts ______ Oxide Slag-ladle 2

Integrator Reading 652-2

7¾

STAND 2

DATE 7-21-76

11/13

SHIFT A

Operation ______ Converter Status Empty

Tuyeres: Found 45 Left 48

Integrator Reading 6689-5

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
						Patched Belly	
4	3	1	12:30	1:30	2		
2	3	1/2	2:35				

Flux-Cans 2 Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT B

Operation CBO Converter Status C-Blowing

Tuyeres: Found 48 Left 48

Integrator Reading 6670-7

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				3:25	2	Hot spot	
2	2 3/4	Collar	4:10	5:00	1 3/4	Low in Belly	1 1/2
		Cut 1/2	5:20	7:09		North of Center	

Flux-Cans 1 Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT C

Operation C-BO Converter Status [illegible]

Tuyeres: Found 48 Left 48

Integrator Reading 6693-7

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
4	3		1:25	2:30	2	[illegible]	
4	4		5:55	6:35	1 1/2		

Flux-Cans 2 1/2 Copper-Reverts ______ Oxide Slag-ladle ______

Integrator Reading 6695-4

REVERBERATORY FURNACE OPERATION

DATE 7-21-76

A SHIFT			B SHIFT			C SHIFT		
BATH MEASUREMENTS			BATH MEASUREMENTS			BATH MEASUREMENTS		
TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE
7.15	22	27	3 15	20	27	11 15	21	27
9.00	20	27	5 00	21	27	1 00	20	27
11:00	19	27+	7 00	20	27+	3 00	20	27
1:00	21	27	9 00	20	27+	5 00	20	27

A SHIFT	B SHIFT	C SHIFT	TOTALS
CANS CHARGED TO FURNACE 20	CANS CHARGED TO FURNACE 18	CANS CHARGED TO FURNACE 20	58
LADLES REVERB SLAG 6 Sample Area	LADLES REVERB SLAG 11 sample Area	LADLES REVERB SLAG 8 sample Area	25
LADLES MATTE 12	LADLES MATTE 4	LADLES MATTE 12	28
LADLES CONVERTER SLAG 7	LADLES CONVERTER SLAG 10	LADLES CONVERTER SLAG 8	25
REMARKS 48-Gal Diesel Fuel #2 Used	REMARKS	REMARKS	
			9 Bag
+14 - 1 - 7+P+L - 3 Bag+P+L	+8 - 7+P+L - 3 Bag+P+L	+10 - 1 - 7+P+L - 3 BAG+P+L	

FORMAN Crosby FORMAN Contreras FORMAN Beasley

Copper Blow Test on A Shift of 7/22/76

1 Converter Gas Stream.

Copper Blow Test on A Shift of 7/22

	Taps	Matte Tons	Flux Tons	Chip Tons	Copper Blow Min	Cu Tons
Converter No 1	8	176	30	20	135	35
Converter No. 2						
Converter No 3.						

Total Weight Charged to Converter on A shift of 7/22

	Matte from Rev.	Chips	Flux	Conct.	Totals
Converter No. 1	176	20	30	0	176
Converter No 2					
Converter No 3					

Total Input into Reverb Furnace. on A Shift of 7/22

Natural Gas.	Air	Conct.	Conv Slag	Ppt.	Lime	Dust
173000	1,820,000 CFM	191	124	8	15	7

STAND 1 15-0-8-23 DATE 7-22-76

SHIFT A

Operation

Converter Status 2 [illegible]

Tuyeres: Found 112
Left 112

Integrator Reading 652-2

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
2	2		[illegible]	[illegible]	[illegible]		1 1/2
		[illegible]	[illegible]	[illegible]			
1	2 1/2		[illegible]	[illegible]	3		
1							
5							

Flux-Cans ✓ Copper-Reverts Oxide Slag-ladle

SHIFT B

Operation CRO

Converter Status 5 [illegible]

Tuyeres: Found 35
Left 35

Integrator Reading 0657-0

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	1		3:20	4:20	1		
	1		4:30	4:55	1	Transfer From 3	2 1/4
	1/4		5:05	5:15			
	1/4		[illegible]	5:40	3/4		
	Calflax	+1/2	6:30	9:15			
4	35		10 30				
4							

Flux-Cans 2 Copper-Reverts Oxide Slag-ladle

SHIFT C

Operation CBO

Converter Status 4 Blowing

Tuyeres: Found 37
Left 37

Integrator Reading 0661-9

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				11 35	[illegible]	Transfer to 3	
4	[illegible]	Dust 3/4	[illegible]	[illegible]	[illegible]		
2	[illegible]	1/4	[illegible]	[illegible]	[illegible]		
8							

Flux-Cans [illegible] Copper-Reverts Oxide Slag-ladle

6 3/4

Integrator Reading 0661-1

DAILY CONVERTER

STAND 3

DATE 2-22-76

SHIFT A

Operation

Converter Status 4 [illegible]

Tuyeres: Found [illegible]
Left [illegible]

Integrator Reading [illegible]

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
4	3	1	2:20			TRANSFER TO #1	

Flux-Cans 1 Copper-Reverts Oxide Slag-ladle

- - - - - - - - - - - - - - - - - - - -

SHIFT B

Operation CBO

Converter Status 4 [illegible]

Tuyeres: Found 48
Left 46

Integrator Reading 6695-8

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				3:20	1½	Transfer to 1	
4	3	Callout ½	9:25	10:15	2		
2							
⑥							

Flux-Cans 1 Copper-Reverts Oxide Slag-ladle

- - - - - - - - - - - - - - - - - - - -

SHIFT C

Operation CBO

Converter Status 6 unblown

Tuyeres: Found 47
Left 47

Integrator Reading 6696-5

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	3	½	11:45	[illegible]	–	Transfer to #1	?
	½		[illegible]	[illegible]			x
		Ca [illegible]	[illegible]	[illegible]			
4	3		[illegible]				

Flux-Cans 2½ Copper-Reverts Oxide Slag-ladle

Integrator Reading 6700-9

REVERBERATORY FURNACE OPERATION

DATE 7-[illegible] 76

A SHIFT			B SHIFT			C SHIFT		
BATH MEASUREMENTS			BATH MEASUREMENTS			BATH MEASUREMENTS		
TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE
7:15	20	27+	3^{15}	20	27	11^{15}	21	27+
9:00	21	27+	5^{00}	20	27+	1^{00}	21	27+
11:00	20	27+	7^{00}	21	27+	3^{00}	20	27+
1:00	20	27	9^{00}	20	27+	5^{00}	20	27

	A SHIFT	B SHIFT	C SHIFT	TOTALS
CANS CHARGED TO FURNACE	16	19	19	54
LADLES REVERB SLAG	8	8	9	25
LADLES MATTE	11	10	12	33
LADLES CONVERTER SLAG	8½	7	11	26 1/2
REMARKS	19-Gal Diesel Fuel #1 Loco			
	+16 -7+P&L -4 Bag+P&L	+7 -4+P&L -6 Bag+P&L	+18 -4+P&L -6 Bag+P&L	16 Bag

FORMAN Crosby FORMAN Contreras FORMAN Rosales

714 Gal Chg Out

Copper Blow Test on A Shift of 7/23/76

1 Converter Gas Stream.

Copper Blow Test on A shift of 7/23

	Tips	Matte Tons	Flux Tons	Chip Tons	Copper Blow Min	Cu Tons
Converter No 1	8	176	35	24	155	52
Converter No. 2						
Converter No 3.						

Total Weight Charged to Converter on A shift of 7/23

	Matte from Rev.	Chips	Flux	Conct.	Total.
Converter No. 1	158	32	45	0	235
Converter No 2					
Converter No 3					

Total Input into Reverb Furnace. on A shift of 7/23

Natural Gas.	Air	Conct.	Conv Slag	Ppt.	Lime	Dust
173,000	1,820,000	159	174	8	13	8

DAILY CONVERTER
11-D[illegible]-37

STAND 1 DATE [illegible]

SHIFT A

Operation ______ Converter Status [illegible]

Tuyeres: Found [illegible] Left [illegible]

Integrator Reading 75 ✓ [illegible]

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	3½		7:15	8:25	[illegible]		[illegible]
		[illegible]	7:05	[illegible]			[illegible]
4	3½	3/4	12:50	1:50	[illegible]		
2		[illegible]	2:20	2:35			
⑥							

Flux-Cans 1½ Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT B

Operation CBO Converter Status 6-Tapes

Tuyeres: Found [illegible] Left [illegible]

Integrator Reading 6669-0

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	3½		4:30	5:50			
1			6:20	6:30	2		2
	½		6:30	7:00	1		
		C 1½ ¼	7:15	9:35		no matte	
⓪							

Flux-Cans 1½ Copper-Reverts 10 R Oxide Slag-ladle ______

SHIFT C

Operation C.B.O Converter Status [illegible]

Tuyeres: Found [illegible] Left [illegible]

Integrator Reading [illegible]

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
4	3		[illegible]	[illegible]	[illegible]		
2	[illegible]		[illegible]	[illegible]			
2	1½	Collar	6:55				
⑧							

Flux-Cans 2½ Copper-Reverts ______ Oxide Slag-ladle 1

9/4

Integrator Reading 6715-0

DAILY CONVERTER

STAND B

DATE 7-23-76

SHIFT A

Operation ______

Convertor Status [illegible]

Tuyeres: Found ______

Left ______

Integrator Reading 6700-7

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
2	3	C [illegible]	[illegible]	[illegible]	3 ½		
2	2	[illegible]	2:50	[illegible]	3		
		[illegible]	3:50				

Flux-Cans 1 3/4

Copper-Reverts ______

Oxide Slag-ladle ______

SHIFT B

Operation CBC

Converter Status Copper B

Tuyeres: Found 45

Left 45

Integrator Reading 6703-4

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
		3/4 ½		4:45			2
1	3		8:40	10:20	2¼		
2	2		10:50				
6							

Flux-Cans 1 3/4

Copper-Reverts ______

Oxide Slag-ladle ______

SHIFT C

Operation C.B.C

Converter Status [illegible]

Tuyeres: Found 41

Left ______

Integrator Reading 6705-7

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				[illegible]	[illegible]		
2	1	[illegible]	[illegible]:35	[illegible]	1		3
		[illegible]	1:20	[illegible]			
2							

Flux-Cans 3

Copper-Reverts ______

Oxide Slag-ladle 3

380<

Integrator Reading 6707-3

REVERBERATORY FURNACE OPERATION

DATE 7-23-76

A SHIFT BATH MEASUREMENTS TIME	IN. SLAG	IN. MATTE	B SHIFT BATH MEASUREMENTS TIME	IN. SLAG	IN. MATTE	C SHIFT BATH MEASUREMENTS TIME	IN. SLAG	IN. MATTE
7:15	20	27	3^{15}	21	27-	11^{15}	21	27
9:00	Working on Conc	Sound ing	5^{00}	21	27-	1^{05}	21	27
11:00	20	27-	7^{00}	21	26	3^{00}	20	27
1:00	20	27	9^{00}	19	27-	5^{00}	19	27-

	A SHIFT	B SHIFT	C SHIFT	TOTALS
CANS CHARGED TO FURNACE	17	16	19	52
LADLES REVERB SLAG	7	9	9	25
LADLES MATTE	10	7	12	29
LADLES CONVERTER SLAG	12	5	9	26

A SHIFT	B SHIFT	C SHIFT
REMARKS 8.8 Gal Diesel Fuel # Used	REMARKS Set down @ 6^{00} to Toolket. start set @ 6^{45} Pm.	REMARKS
+21 - 17 - 3 Foam [illegible]	+7 - 3 - 4 HPH - 5 Bear [illegible]	+16 - 7 HPH - 3 [illegible]

11 Beg

FORMAN Crosby FORMAN [illegible] FORMAN [illegible]

Copper Blow Test on A Shift of 7/26/76

382<

1 Converter Gas Stream.

Copper Blow Test on A shift of 7/26

	Taps	Matte Tons	Flux Tons	Chip Tons	Copper Blow Min.	Cu Tons.
Converter No 1	8	126	23	20	150	52
Converter No. 2						
Converter No 3.						

Total Weight Charged to Converter on A shift of 7/26

	Matte from Rev.	Chips	Flux	Conct.	Total.
Converter No. 1	63	20	0	0	83
Converter No 2					
Converter No 3					

Total Input into Reverb Furnace. on A shift of 7/26

Natural Gas.	Air	Conct.	Conv Slag	P.pt.	Lime	Dust.
176,000/cuft/hr.	1810000 cfm.	175	116	6	15	8

1 Converter Gas Stream.

Copper Blow Test on B shift of 7/26

	Taps	Matte Tons	Flux Tons	Chip Tons	Copper Blow Min	Cu Tons.
Converter No 1						
Converter No. 2						
Converter No 3.	8	126	58	8	110	35

Total Weight Charged to Converter on B shift of 7/26

	Matte in Rev.	Chips	Flux	Conct.	Total.
Converter No. 1					
Converter No 2					
Converter No 3	63	12	28	0	103

Total Input into Reverb Furnace. on B shift of 7/26

Natural Gas.	Air	Conct.	Conv Slag	Ppt.	Lime	Dust.
176,000	1,820,000	165	87	5	12	6

DAILY CONVERTER
15-0-13-28

STAND 1

DATE 7-26-76

SHIFT A

Operation ______ Converter Status S Blowing

Tuyeres: Found ______
Left ______

Integrator Reading [illegible] 707

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				8:00	2		1
	Collar	Cu 1½	8:30	11:30			½
4		½					

Flux-Cans ______ Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT B

Operation ______ Converter Status 9-Taps

Tuyeres: Found 28
Left 28

Integrator Reading 0700-0

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	2½		4:45	5:45			
1			6:10	6:30			
1			6:45	7:10	2		
2	2½		7:40	8:40	1		
	1½		8:50	9:25	2		
	¾		10:05	10:20	1¼		
	Cu	¾	10:40				

Flux-Cans 2 Copper-Reverts 1-M Oxide Slag-ladle ______

SHIFT C

Operation [illegible] Converter Status Cu Blowing

Tuyeres: Found 28
Left 28

Integrator Reading 1047

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
		Cu ½		1:00			1
4	3		5:10	6:10	2		2

Flux-Cans 1 Copper-Reverts ______ Oxide Slag-ladle 1

Integrator Reading 707-6

DAILY CONVERTER

STAND 3

DATE 7-26-76

15.0

SHIFT A

Operation

Convertor Status [illegible]

Tuyeres: Found 48

Left 48

3√3

Integrator Reading 6726-3

3.0

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
2	2		11:20	12:50	2		
2	2½	½	1:55	2:00	2		
			2:05	3:10	½		
	Collar	Out	3:30				

Flux-Cans 13¼

Copper-Reverts

Oxide Slag-ladle

SHIFT B

Operation 6130

Converter Status Copper 13

Tuyeres: Found 48

Left 48

Integrator Reading 6728-6

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
		¾		7:40			1½
④		½ DUST					

Flux-Cans

Copper-Reverts

Oxide Slag-ladle

SHIFT C

Operation 130

Converter Status [illegible]

Tuyeres: Found 48

Left 48

Integrator Reading 6730.1

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	2		1:00	1:50	2		1¾
2	2	½	2:05	3:00	1½		
	½		3:05	3:15	1		
		Cu. ¾ ½ ½	3:25	5:10			
4	2	¾ dust	6:25				

Flux-Cans 2¼

Copper-Reverts 9 rejects

Oxide Slag-ladle 11

Integrator Reading 6731-3

386<

REVERBERATORY FURNACE OPERATION 7 1/2 1 1/2 DATE 7-26-76

A SHIFT			B SHIFT			C SHIFT			
BATH MEASUREMENTS			BATH MEASUREMENTS			BATH MEASUREMENTS			TOTALS
TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	
7:15	17	27	3 15	23	27	11 15	Floater		
9.00	[illegible]	27	5 00	20	27	1 00	21	27	
11:00	20	27	7 00	20	27	3 00	20	27	
1:00	20	27	9 00	20	27	5 00	19	27	
CANS CHARGED TO FURNACE	20		CANS CHARGED TO FURNACE	18		CANS CHARGED TO FURNACE	18		56
LADLES REVERB SLAG	7		LADLES REVERB SLAG	10		LADLES REVERB SLAG	9		26
LADLES MATTE	8		LADLES MATTE	8		LADLES MATTE	10		26
LADLES CONVERTER SLAG	8		LADLES CONVERTER SLAG	6		LADLES CONVERTER SLAG	8		22
REMARKS			REMARKS			REMARKS			9
+15 - 7+P+L - [illegible]			+13 - [illegible] 2+P+L - [illegible]			+8 - 1 - 7+P+L 3 [illegible]			

FORMAN

FORMAN

FORMAN

387<

Copper Blow Test on A Shift of 7/27/76

1 Converter Gas Stream.

Copper Blow Test on A. shift of 7/27

	Taps	Matte Tons	Flux Tons	Chip Tons	Copper Blow Min	Cu Tons.
Converter No. 1	4					
Converter No. 2	4					
Converter No 3.	4 Transfer =	126	12	12	120	35

Total Weight Charged to Converter on A shift of 7/27

	Matte in Pot.	Chips	Flux	Conct.	Total.
Converter No. 1	4				
Converter No 2	4				
Converter No 3	4 Transfer =	126	12	4	0	142

Total Input into Reverb Furnace. on A. shift of 7/27

Natural Gas.	Air	Conct.	Conv Slag	P.pt.	Lime	Dust
175000 Cft/hr.	1,820000 CFM.	142	131	2	11	8

SHIFT A

Operation ____ Converter Status 4 Blowing Tuyeres: Found 118 Left 118 Integrator Reading 39.4 6[illegible]51.3 5.1

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				7:30	2		
			7:55	8:10	1		
	4		8:15	8:25	½		
		Cu 1¾	8:35	10:35			1½
4	1½		11:45	12:35	3		
2	2½	½	12:50	1:50	2		
		Cu 1 3/4					
18							

Flux-Cans 2 Copper-Reverts ____ Oxide Slag-ladle ____

SHIFT B

Operation CBO Converter Status 8-Taps Tuyeres: Found 48 Left 48 Integrator Reading 6738.8

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	2½		3:15	4:10		Except for one ladle	
						this charge was dumped	
4		1				on the ground-BO Control	
						Circuits. Aux. Control is	
						Now disconnected. Main	
4						Controller is O.K.	
						"C and A" shift foremen	
						See accident Report	

Flux-Cans 3/4 Copper-Reverts ____ Oxide Slag-ladle ____

SHIFT C

Operation CBO Converter Status 4 on blowing Tuyeres: Found 48 Left 48 Integrator Reading 6739.7

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	3		12:15	1:15	2		
	½		2:25	2:45	1½	Transfer 4 from #5	
2	3		2:50	3:50	1¾		2
	2¼		3:55	4:40	2¼		
		Cu 1¾	4:50	7:00			

Flux-Cans 3 Copper-Reverts ____ Oxide Slag-ladle ____

Integrator Reading [illegible]

REVERBERATORY FURNACE OPERATION

DATE 7-27-76

A SHIFT			B SHIFT			C SHIFT			TOTALS
BATH MEASUREMENTS			BATH MEASUREMENTS			BATH MEASUREMENTS			
TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	
7:15	21	27	3 15	21	27	11 10	21	27	
9.00	21	27	5 00	18	27	1 00	21	27	
11:00	20	27+	7 00	19	27	3 00	20	27+	
1:00	21	27		19	27	5 00	20	27	
CANS CHARGED TO FURNACE	16		CANS CHARGED TO FURNACE	18		CANS CHARGED TO FURNACE	18		52
LADLES REVERB SLAG	8		LADLES REVERB SLAG	8		LADLES REVERB SLAG	10		26
LADLES MATTE	8		LADLES MATTE	10		LADLES MATTE	10		28
LADLES CONVERTER SLAG	9		LADLES CONVERTER SLAG	6		LADLES CONVERTER SLAG	11		26
REMARKS 50.7 Gal Diesel Fuel #1 Loco			REMARKS			REMARKS			
+14 -7+P+L -3 Bag +P+L			+17 -9+P+L -6+L			+ 10 - 6+P+L -4+L			

FORMAN Crosby FORMAN Contreras FORMAN Rowley

Copper Blow Test on A Shift of 7/28/76

CONVERTER GAS ~~STEAM~~ STream

Copper Blow Test on A Shift of 7/28

Table I

	Tops	Matte Tons	Flux Tons	Chip Tons	Minutes Cu Blow	Copper Tons
Converter No. 1	8	126	20	16	210	65
Converter No. 2						
Converter No. 3						

Table II Total Weight Charged to Converter on A Shift of 7/28

	Matte from Reverb	Chips	Flux	Conct	Total
Converter No. 1	63	16	20	0	99
Converter No. 2					
Converter No. 3					

Table III

Total Input into Reverb Furnace on A Shift of 7/28.

Natural Gas	Air	Conct.	Conv. Slag	Ppts	Lime	Dust
173,000	1,820,000	171	93	4	14	6

Chips Added to the converters includes dust. For example: (we estimate 1/3 is dust.)

16 tons of chips would contain.

16/3 = 5.3 tons recycle flue dust

And 10.7 tons of other solid material

393<

CONVERTER GAS ~~S[illegible]~~ STream

Copper Blow Test on B Shift of 7/28/76

Table I

	Taps	Matte Tons	Flux Tons	Chip Tons	Minutes Cu Blow	Copper Tons
Converter No. 1						
Converter No. 2						
Converter No. 3	8	126	18	16	135	55

Table II Total Weight Charged to Converter on B Shift of 7/28/76

	Matte from Reverb	Chips	Flux	Conct	Total
Converter No. 1					
Converter No. 2					
Converter No. 3	126	16	36	0	178

Table III

Total Input into Reverb Furnace on B Shift of 7/28

Natural Gas	Air	Conct.	Conv. Slag	Ppts	Lime	Dust
173,000	1,820,000	159	110	7	17	5

[illegible] 1 11-0-19=30 DATE [illegible]-25-76

Operation ______ Converter Status 2 Blowing

Tuyeres: Found 39 Left 37

Integrator Reading ret 3 714.7 9.6

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				8:00	3		
1	3½		8:30				
1			8:45	9:40	2		
1	2½		9:50				
1			10:05	10:45	2		2 3/4
		Cu Bks	11:00	2:10			2 ½

Flux-Cans √ Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT B

Operation ______ Convertor Status [illegible]

Tuyeres: Found 39 Left 39

Integrator Reading 0721-0

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
4	2	½ Dust	4:20	5:10	2 3/4	Transfer to 3	
4	3½	Collar + 1½	9:55	10:35	1½		
4	Skimmed						

Flux-Cans 1 3/4 Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT C

Operation BO Converter Status Unskimmed

Tuyeres: Found 39 Left 39

Integrator Reading 0723.0

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
						Transfer to #3	
4	4½	3/4	5:50				

Flux-Cans 1 1/3 Copper-Reverts ______ Oxide Slag-ladle 11

7/1/x 395<

Integrator Reading 72[illegible]-3

53.7 15.?

Operation________ Converter Status Empty

Tuyeres: Found 48
Left 48

Integrator Reading 6744-1

96

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
4	2 1/2	1/2 dust	2:40				

Flux-Cans 2/3 Copper-Reverts________ Oxide Slag-ladle________

SHIFT B

Operation________ Converter Status 4-Taps

Tuyeres: Found 48
Left 48

Integrator Reading 6744-2

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				3:40	2 3/4	Transfer Fr. 1	
	1		5:45	6:10	1 1/2		2 1/4
	3/4		6:20	6:40	1		
	Collar+1	1/2 3/4 1/2	7:15	9:30			
4	3		10:40				
(4)							

Flux-Cans 1 3/4 Copper-Reverts________ Oxide Slag-ladle________

SHIFT C

Operation________ Converter Status 4 Blowing

Tuyeres: Found 48
Left 48

Integrator Reading 6748.2

Matte Ladles	Flux Bins	Revert's Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				12:00	2 3/4	Transfer 4 from #1	
			12:30	12:45	2		
	1/2		12:50	1:00	1/2		
2	2 3/5		1:05	2:05	2 1/2		2 1/2
	1/2		2:10	2:25	1		
	1/2		2:30	2:40	1/2		
		Cu. 1 3/4 1/24	2:45	5:45			
(4)							

Flux-Cans 1/3 Copper-Reverts________ Oxide Slag-ladle 1

Integrator Reading 67537

REVERBERATORY FURNACE OPERATION

DATE 7-28-76

A SHIFT			B SHIFT			C SHIFT			
BATH MEASUREMENTS			BATH MEASUREMENTS			BATH MEASUREMENTS			TOTALS
TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	
7:15	19	27	3^{00}	19	27+	11^{15}	20	27	
9:00	21	27+	5^{00}	19	27	1^{00}	20	27	
11:00	20	27+	7^{00}	20	27	3^{00}	20	27+	
1:00	20	27+	9^{00}	19	27	5^{00}	19	27+	

CANS CHARGED TO FURNACE 19	CANS CHARGED TO FURNACE 18	CANS CHARGED TO FURNACE 17	54
LADLES REVERB SLAG 5	LADLES REVERB SLAG 6	LADLES REVERB SLAG 9	20
LADLES MATTE 8	LADLES MATTE 12	LADLES MATTE 10	30
LADLES CONVERTER SLAG 6	LADLES CONVERTER SLAG 11	LADLES CONVERTER SLAG 9	26
REMARKS 27.8 Gal. Diesel Fuel #1 Loco	REMARKS	REMARKS	
+19 - 10+P+L	+19 - 6+L - 9+P+L	+8 - 2+L - 10+P+L	

FORMAN Crosby

FORMAN Contreras

FORMAN Rosky

Copper Blow Test on A Shift of 7/29/76

CONVERTER GAS STreAm

Copper Blow Test on A Shift of 7/29/76

Table I

	Tops	Matte Tons	Flux Tons	Chip Tons	Minutes Cu Blow	Copper Tons
Converter No. 1						
Converter No. 2						
Converter No. 3	8	176	25	16	120	50

Table II Total Weight Charged to Converter on A Shift of 7/29/76

	Matte from Reverb	Chips	Flux	Conct	Total
Converter No. 1					
Converter No. 2					
Converter No. 3	192 TONS	20 tons	20 tons	0 tons	232 tons

Table III

Total Input into Reverb Furnace on A Shift of 7/29.

Natural Gas	Air	Conct.	Conv. Slag	Ppts	Lime	Dust
174000 Cu ft/hr.	1820000 Cu ft/hr	154 tONS.	160 tons	2 tons	14 tons	8 tons

Indicated units

Also, if concentrate is charged into the converters it is mixed with the flux. The percentage would be very low so figures for concentrate to the converters are usually given daily.

CONVERTER GAS ~~[illegible]~~ STREAM

Copper Blow Test on B Shift of 7/29/76

Table I

	Taps	Matte Tons	Flux Tons	Chip Tons	Minutes Cu Blow	Copper Tons
Converter No. 1						
Converter No. 2						
Converter No. 3	8	176	15	16	125	40

Table II Total Weight Charged to Converter on B Shift of 7/29/76

	Matte from Reverb	Chips	Flux	Conct	Total
Converter No. 1					
Converter No. 2					
Comverter No. 3	79	24	15	0	118

Table III

Total Input into Reverb Furnace on ____ Shift of ______

Natural Gas	Air	Conct.	Conv. Slag	Ppts	Lime	Dust
174000 Cuft/hr	1,820,000 Cuft/hr	166	116	4	16	6

STAND 1

DATE 1-29-76

Operation ______ Converter Status H Blowing

Tuyeres: Found 39 Left 39

Integrator Reading 724-3 270

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				2:10	3	TRANSER TO #3	
4	3½		12:20	1:30	3	TRANSFER to #3	

Flux-Cans 1 Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT B

Operation CBO Converter Status 2-Taps

Tuyeres: Found 39 Left 39

Integrator Reading 0725-6

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
2	4½	1	6:05	7:25	2¾	Transfer To 3	
4		Collar					
⑨							

Flux-Cans 1⅓ Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT C

Operation ______ Converter Status Hung Down

Tuyeres: Found 39 Left 39

Integrator Reading 726.8

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	4½		1:00	2:05	2	Transfer to #3	
④							

Flux-Cans 1⅓ Copper-Reverts ______ Oxide Slag-ladle ______

53/6 401<

Integrator Reading 727-0

0-0-[illegible] 133

Operation______ Converter Status [illegible] Tuyeres: Found 48 Left 48 Integrator Reading 6753-7

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
	3		7:[illegible]	8:30	3	TRANSFER from #[illegible]	1
			8:55	9:30			
	¼		9:32	9:[illegible]0	1/4		2
	Collar	Cu Blk	10:15	12:15			
4	3		1:30	2:30	2	TRANSFER From #[illegible]	1
			2:55				

Flux-Cans ✓ Copper-Reverts______ Oxide Slag-ladle______

SHIFT B

Operation______ Converter Status 8-taps Tuyeres: Found 48 Left 48 Integrator Reading 6758-4

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				3:15	3/4		
	½		3:20	3:30			1 [illegible]
	¼		3:40	3:50	3/4		
		Cu 3/4 1/4	3:55	6:00			
3/4	2	1 Dust	7:35	8:25			
1			8:45	9:05	2½	Transfer Fr. 1	
			9:15	9:55	½		
		Cu 1	10:00				

Flux-Cans 1⅓ Copper-Reverts______ Oxide Slag-ladle______

SHIFT C

Operation______ Converter Status Cu. Blowing Tuyeres: Found 48 Left 48 Integrator Reading 6763.2

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
		Cu ½ ½ ¼		1:00			2
4	2½		2:10	3:10	3	Transfer 4 from #1	
			3:40	3:50	1		
	½		3:55	4:10	½		
		Cu. Collar ½ ¾ ½	4:50				

Flux-Cans 1 Copper-Reverts______ Oxide Slag-ladle______

Integrator Reading 6769-1

402<

REVERBERATORY FURNACE OPERATION

DATE 7-27-76

A SHIFT			B SHIFT			C SHIFT			
BATH MEASUREMENTS			BATH MEASUREMENTS			BATH MEASUREMENTS			TOTALS
TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	
7:15	19	27	3^{15}	20	27	11^{15}	20	27	
9:00	21	27	5^{00}	20	27+	1^{00}	20	27	
11:00	21	27+	7^{00}	19	27	8^{00}	20	27	
1:00	19	27+	9^{00}	19	27+	5^{00}	19	27	
CANS CHARGED TO FURNACE 17			CANS CHARGED TO FURNACE 18			CANS CHARGED TO FURNACE 20			55
LADLES REVERB SLAG 5			LADLES REVERB SLAG 9			LADLES REVERB SLAG 8			22
LADLES MATTE 10			LADLES MATTE 11			LADLES MATTE 8			29
LADLES CONVERTER SLAG 11			LADLES CONVERTER SLAG 8			LADLES CONVERTER SLAG 8			27
REMARKS 25.5 Gal Diesel Fuel #1 Loco			REMARKS			REMARKS			
+17 - 10 + P+L			+11-7+L-8+P+L			+9 - 3+L - 10 + P+L			

FORMAN Crosby

FORMAN Contreras

FORMAN Rosales

Copper Blow Test on A Shift of 7/30/76

CONVERTER GAS [illegible] STREAM

Copper Blow Test on A Shift of 7/30

Table I

	Taps	Matte Tons	Flux Tons	Chip Tons	Minutes Cu Blow	Copper Tons
Converter No. 1						
Converter No. 2						
Converter No. 3	8	126	20	16	150	50

Table II Total Weight Charged to Converter on ___ Shift of ________

	Matte from Reverb	Chips	Flux	Conct	Total
Converter No. 1					
Converter No. 2					
Converter No. 3	189	20	25	0	234

Table III

Total Input into Reverb Furnace on ___ Shift of ________.

Natural Gas	Air	Conct.	Conv. Slag	Ppts	Lime	Dust
167,000	1,820,000	188	131	0	15	9

RD 3 a o-29/29 DATE 7-30-76

Operation ______ Convertor Status Cu Blowing Tuyeres: Found 48 Left 48 Integrator Reading 54 3 6746.921 15

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
		Cu		7:30			2¼
	3		8:50	9:50	3		
	1		10:20	11:00	1		2
		Cu 1½	11:10	1:40			
4	3		2:40				

Flux-Cans 2½ Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT B

Operation CAD Converter Status 4 P Tuyeres: Found 37 Left 38 Integrator Reading 67739

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				3:35	2¾		
	2		4:15	5:00	1	Transfer Fr 1	
			5:15	5:25	¾		1¾
	Cu	¾ ½	5:55	7:50			
4	2	¼ Dust	9:10	9:55	2½	Transfer Fr 1	
	1½		10:30			" " "	

Flux-Cans 2 Copper-Reverts ______ Oxide Slag-ladle ______

SHIFT C

Operation ______ Converter Status Blowing Tuyeres: Found 38 Left 38 Integrator Reading 6779.0

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
				11:20	1		
	1		11:20	11:45	¾		1½
		Cu 1¾	11:50	1:10		Transfer 4 from # 1	
2			3:10	3:40	1½		
	1		3:45	4:00	1		2
		Cu ½ ½	4:15	6:20			

Flux-Cans 1 Copper-Reverts Rejects 1 Mold Oxide Slag-ladle 1

-11 406<

Integrator Reading 7813

[illegible]

Operation______ Convertor Status 4 unblown

Tuyeres: Found 39 Left 39

Integrator Reading 31 ½ 10" [illegible]

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
—	4½		7:30	8:45	3½	Transfer to No. 3	
4	3½		7:40	9:45	1¾		

Flux-Cans 2½ Copper-Reverts______ Oxide Slag-ladle______

SHIFT B

Operation______ Converter Status 4-Skimmed

Tuyeres: Found 38 Left 38

Integrator Reading 0720.0

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
4	4½	1	7:55	9:00	2¾	Trans[illegible] 3	

Flux-Cans 1½ Copper-Reverts______ Oxide Slag-ladle______

SHIFT C

Operation______ Converter Status Empty

Tuyeres: Found 39 Left 39

Integrator Reading 731.12

Matte Ladles	Flux Bins	Reverts Boats	Blowing Time Start	Blowing Time Stop	Slag	Remarks-Blowing and Idle Time Data	Copper Ladles
4	3½		1:45	2:35	2	Transfer to # 3	

Flux-Cans 1 Copper-Reverts______ Oxide Slag-ladle 1

Integrator Reading 731.8

REVERBERATORY FURNACE OPERATION

DATE 7-30-76

A SHIFT			B SHIFT			C SHIFT		
BATH MEASUREMENTS			BATH MEASUREMENTS			BATH MEASUREMENTS		
TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE	TIME	IN. SLAG	IN. MATTE
7^{15}	20	27+	3^{15}	20	27+	11^{15}	20	27
9^{00}	20	27	5^{00}	19	27+	1^{00}	19	27
11^{00}	22	27	7^{00}	19	27	3^{00}	19	27
1^{00}	19	27	9^{00}	19	27	5^{00}	19	27
						7^{00}	19	26-

	A SHIFT	B SHIFT	C SHIFT	TOTALS
CANS CHARGED TO FURNACE	20	19	10	49
LADLES REVERB SLAG	6	10	12	28
LADLES MATTE	12	8	6 to Conv. 13 To Matte Bed	26 13
LADLES CONVERTER SLAG	9	11	8	28
REMARKS	30 gals Diesel fuel #1 Loco	REMARKS	13 Ladles of Matte to Matte Bed	
	+15-2-10##L	1-12-10		

731 Gal Diesel Oil
To Mg

FORMAN Rosale
Contreras

FORMAN Contreras

FORMAN Rosales